STATE BOARD OF TECHNICAL EDUCATION & TRAINING::AP,VIJAYAWADA

DIPLOMA IN CIVIL ENGINEERING

III SEMESTER

HYDRAULICS LAB (C-310)

MANUAL (AS PER C-20 CURRICULUM)

INDEX

1. INTRODUCTION

INTRODUCTION

1.0 INTRODUCTION

The Curriculum of Technical Education should invariably provide for knowledge, attitudes and skills required by the technicians /technologists in the country. In this context the laboratory courses form a vital portion in the entire curriculum of technician education. The laboratory courses shall therefore be so designed and delivered that they help the students acquire attitudes and motor skills that are essential to function effectively as technicians/technologists.

The planning, organization and implementation of lab courses need a detailed description of tasks to be performed by the students. Well thought out instructional objectives to a large extent give these descriptions. The analysis of tasks (by identifying the activities the students are expected to do) help prepare the objectives meticulously. In other words the objectives would be clearer, when the task analysis is done to spell out the sub tasks for each objective.

A survey of the practices currently followed in the technical/technician education shows an urgent need to plug in gaps in instructional procedures. The reasons for these gaps are ambiguity in the minds of the teachers regarding tasks to be performed, levels of competency to be achieved by the students and the weightage to be allocated for each task. This aids in scientific design of instructional plan (optimizing the resources, budgeting the time & content).

The task analysis, teaching points and the structured scheme of evaluation are very important in focusing the instruction on specific skill of desired outcome and in evaluating the same. The Instruction and evaluation in Laboratory courses are different from that of cognitive lessons in the sense that adequate importance and hence weightage needs to be given for all three domains of learning viz. cognitive, psychomotor and affective. Since both training and evaluation of traits of affective domain are practically difficult, a few traits (called values) most relevant and essential to occupations/professions after the Course may be identified for the purpose. It is imperative to integrate these values during instruction and evaluation and also overtly notify the same to the students.

A technician, in addition to performing a skill needs to prepare a report of testing that includes the description of procedure, details of measurements made, reasoning based inferences and so on.,. The current practice of record writing has failed to achieve this purpose as most of the time students end up with making copies of available material.

Therefore, for sensitizing the need for the changes in laboratory instruction, the present hand book has been prepared to meet the above requirements. As such the hand book comprises four parts that intend to :

- Present task analysis, teaching points which can be used for effective design of instruction
- provide a scheme of evaluation with rationally allocated weightage to each significant skill component
- offer a set of questions designed at different levels of competencies for assessment enabling the teacher to set the question paper with balanced levels of competencies
- present pre set worksheets that cultivate the habit of systematic recording of observations and writing the technical report.
- Provide all important data related to particular laboratory activity at one point in the form of annexure

1.1. STRUCTURE OF THE BOOK

The hand book is presented in four parts viz., Laboratory sheets, Worksheet, Experimental Methodology and Annexure. The description of each part is given in the following sections

Part I. Laboratory Sheet

The information provided in this part is useful for the teacher for designing the instruction, planning & organization of the experiment and for scientific evaluation of the students. The major features of the Laboratory sheet are further explained below.

1. **Objective**

   It indicates the **Task** to be performed and completed by the student during the specified duration of time.

2. **Task Analysis**

It is the process of identifying the component activities (sub tasks) to be carried out by the student in order to achieve the stipulated objective. As the task analysis aim at fitting the instructional objectives into various classes of behaviour, it would help the teacher to determine any particular type of behaviour the student has learnt / failed to perform.

The task analysis would help the teacher in identifying the specific activities to be performed by the students. This could also be used as some kind of check list to compare with activities planned for the laboratory. Further it would give clue to the teacher to make students think originally & act independently. It includes both psychomotor learning and the related cognitive information and hence the task analysis is presented as Knowledge and skill parts.

A. Knowledge Part: That includes the cognitive aspects of the task.

B. Skill Part: That includes Psychomotor & Affective aspects of the task.

3. **Teaching Points:**

This includes the points based on the SKILL identified with suggested duration for each point and total duration which helps the teacher for the time and content budgeting during instruction.

4. **Need and Scope:**

The purpose, application and scope of the task to be performed are normally included in this sub section.

5. **Planning and Organisation:**

It lists actions to be taken to perform various activities and hence useful in planning the instruction and organizing the resources and equipment

6. **Scheme of Valuation:**

The information provided in this section helps the teacher to devise a tool for rational measurement assessment of the competencies accomplished by the student.

Part II. Work Sheet

It is designed for the student, where in the student enters his personal data of identification, details of the experiment, stepwise procedure, observations made during experiment, a sample calculation, free hand typical graph, graph from experimental data and inference with discussion.

Part III. Experimental Methodology

This section furnishes information with regard to standard procedure to conduct the experiment along with the description of equipment/apparatus and the basic theory/concept involved in the conduct of the experiment. Thus this section is very useful for both teacher and student as well to conduct the experiment systematically. Thus this section is presented in four sub section as described below:

- **Description**

It gives the detailed description of apparatus / tools / equipment / materials to be used for the task.

- **Theory / Concept**

It gives the concept of the task to be performed with formulae and units.

- **Procedure**

It provides the idea of step wise procedure to perform the task.

- **Observation and Calculation**

It includes sample observation, sample graph, sample calculation for reference

Part IV. Annexure

All important and useful information that may help in accomplishment of tasks like conversion tables for units, technical & scientific data like material properities, standard trend or characteristic curves (graphs) etc are compiled and presented at one place in this section.

1.2. WHO IS TO USE AND HOW TO USE.

The hand book is so designed that it can be beneficially used by different sections of the technical education viz., the teacher, the student, the examiner and the administrator convenient to individual's requirements. A few uses of this hand book each stakeholder could make is outlined in the following sections.

1. Teacher

A. The **laboratory sheet** is designed keeping the teacher in mind for the teacher has key responsibility of imparting the skills to the student and hence the information given in the lab sheets may be useful for planning & organizing the experimental set up and designing an effective instruction. Thus the teacher may

Plan and organize as per *section 4,*
Instruct the students as per *section 2***,**
Demonstrate each sub task as per *section1.B*.and
Evaluate the students as per *section 5***,** according to the level of competency.

Values: The values in a person are an important personality trait that needs to be nurtured in the learning environment. Further it is also a driving component in any individual to deliver the best and hence this component is also included in the evaluation. However only five key dimensions, that are important in the teaching-learning environment, are taken into consideration for nurturing and evaluation. A little information about these five dimensions is given below as a guideline for the teacher while assessing students.

1. Co-operation: It is the voluntary arrangement in which two or more students engage in a mutually beneficial exchange, instead of competition. Cooperation can happen where resources adequate for both students exist or are created by their interaction.

2. Co-ordination: It is the unification, integration, synchronization of the effect of group members so as provide unity of action in the pursuit of common goals. It is an integral element and required in each & every function and at each & every stage & therefore it cannot be separated.

3. Communication; Communication skill is the set of skills that enables a student to convey information so that it is received and understood.

4. Sharing: A part or portion belonging to, distributed to, contributed by, owed by a person or a group **Or** To participate in, use, enjoy or experience jointly or in turns.

s5. Leadership: Students with the following leadership qualities are almost always the ones that rise above the crowd.

1. Trustworthiness: This refers to integrity.
2. Inspiration: Guides, leads and inspiring others to want to participate in the process of moving towards the vision.
3. Self awareness: It is the individual awareness of him or her self – their abilities and the impact that they have on others.
4. Acceptance of responsibility: True leaders are accepting responsibility for all that comes their way and taking ownership and responsibilities for getting things back on track. Blaming, justifying and excuse making just is not in their responsibility.

B. The **Experimental methodology** is designed for both teacher and student. The teacher can refer the experimental methodology for the details of equipment/apparatus/ materials/tools, procedure to be followed, observations to be made, graphs to be drawn and calculations to be done for the task to be performed

2. Student

The Worksheet is designed keeping in view the needs, deficiencies and the adolescent characteristics of the student for student.

The students submit the filled in work sheet given by the teacher on the day of experiment after referring to experimental methodology and listening to instructions of teacher. The design of the worksheet is made user friendly and the contents are so logically sequenced that the student finds it easy to understand and develop the skill of recording and report writing skill. It also helps the student to actively participate in skill learning. More importantly the student gets immediate meaningful feedback of his performance since the competency wise assessment is done and that too on the same day.

3. Examiner

The examiner may find this hand book very useful as Laboratory sheets and Scheme of evaluation provides information with regard to various competencies (skills) the students is expected to acquire during the course of study and the relative weightages of each competency. This information helps him to design a well balance question paper/measurement tool for assessment.

2.LABORATORY SHEETS

2.1.1 DETERMINATION OF COEFFICIENT OF DISCHARGE OF A SMALL ORIFICE BYCONSTANT HEAD METHOD

OBJECTIVE

To perform constant head method of a small orifice to determine coefficient of discharge.

EQUIPMENT/APPARATUS/RESOURCES

1. Orifice fitted to an orifice tank,
2. Piezometers,
3. Meter scale,
4. Calipers,
5. Stop watch,
6. Collecting tank fitted with control valve,

1. TASK ANALYSIS

A. KNOWLEDGE

- Operating valves
- Usage of stopwatch
- Usage of vernier calipers
- Reading values on piezometer
- Unit conversations
- Taking dimensions of collecting tank.

B.SKILLS

Category of Skill	Sub task
1. Handling of apparatus	• Using meter scale to measure dimensions of collecting tank and recording its dimensions. • Using Vernier calipers to measure the diameter of Orifice. • Priming the motor before switching on. • Operating outlet valve of collecting tank for taking T & Hfor calculation of Q_a, without overflowing it.
2.Manipulation of apparatus	• Measure the time required (T) to rise the water level to a desired height (H) after closing outlet valve in the colleting tank. • Convert all measurements into single unit
3. Precise operation /activity	• Maintaining constant head in Piezometer. • Preparation of graph with the observed values and adding a trend line, measuring slope of it and finding out the C_d from graph.

2. TEACHING POINTS

S. No.	Teaching points	Suggestive Duration (Min.)
1.	Description about Orifice A. Importance of Orifice B. Types of Orifice C. Applications of Orifice	5
2.	What is C_d	
3.	Standard C_d value for Orifice	
4.	Methods of finding out coefficient of discharge for Orifice	4
5.	Calculating actual discharge and theoretical discharge	6
6.	Calculating C_d	
7.	Precautions	
	A. Procedural precautions • Care should be taken in operating valves. • Time should be noted very carefully and accurately. Proper care should be taken in recording the reading and calculating the C_d	
	Total	15

3. NEED AND SCOPE OF THE EXPERIMENT

COEFFICIENT OF DISCHARGE:

This parameter is useful for determining the irrecoverable losses associated with a certain piece of equipment in a fluid system or the resistance that piece of equipment imposes upon the flow.

This flow resistance often expressed as a dimensionless parameter.

ORIFICE

All openings cannot be considered as an Orifice unless the water level on the upstream side is above the opening. The purpose of the Orifice is to measure the discharge. Orifice is used where water surface is exposed to the atmosphere.

4. PLANNING AND ORGANIZATION

Action	Activity
Check for	1. Working condition of motor and stopwatch. 2. Functioning of valves. 3. Availability of quality & sufficient quantity of water. 4. marked reading on piezometer
For design of Instruction	Read the teaching points carefully.

5. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub Task</th><th>Weight with competency level individually</th><th>Awarded
(50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A. Using meter scale to measure dimensions of collecting tank and recording its dimensions.
B. Using Vernier calipers to measure the diameter of Orifice.
C. Priming the motor before switching on.
D. Operating outlet valve of collecting tank for taking T & H for calculation of Q_a, without overflowing it.</td><td><table><tr><th>Skill</th><th>Max</th><th>Award</th></tr><tr><td>A</td><td>2</td><td></td></tr><tr><td>B</td><td>3</td><td></td></tr><tr><td>C</td><td>2</td><td></td></tr><tr><td>D</td><td>3</td><td></td></tr><tr><td>Total</td><td>10</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation of apparatus</td><td>A. Measure the time required (T) to rise the water level to a desired height (H) after closing outlet valve in the colleting tank.
B. Convert all measurements into single unit.</td><td><table><tr><th>Skill</th><th>Max</th><th>Award</th></tr><tr><td>A</td><td>7</td><td></td></tr><tr><td>B</td><td>8</td><td></td></tr><tr><td>Total</td><td>15</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/Activity</td><td>A. Maintaining constant head in Piezometer.
B. Preparation of graph with the calculated values and adding a trend line, measuring slope of it and finding out the Cd from graph.</td><td><table><tr><th>Skill</th><th>Max</th><th>Award</th></tr><tr><td>A</td><td>10</td><td></td></tr><tr><td>B</td><td>10</td><td></td></tr><tr><td>Total</td><td>20</td><td></td></tr></table></td><td></td></tr>
</table>

4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	<table><tr><td>Skill</td><td>Max</td><td>Award</td></tr><tr><td>A to E</td><td>5</td><td></td></tr></table>	
Total		50	

6. ASSESSMENT QUESTIONS(Only suggestive)

1. lower level
    a. Measure the dimensions of the collecting tank in orifice apparatus?
    b. Measure the diameter of the orifice in orifice apparatus?
    c. What precautions do you take to avoid the over flow of collecting tank?

2. Medium level
    a. How do you operate stop watch for taking time required for collecting specific height of water in collecting tank?
    b. How do you convert the units from cm^3/s to m^3/s.
3. Difficult level
    a. How do you maintaining constant head in Piezometerin orifice apparatus?
    b. How do you preparethe graph with the calculatedvaluesin small orifice apparatus?
    c. How do you draw a trend line and how you find itsslope?
    d. How do you calculate the Cd from graphin orifice apparatus?

7. VIVA QUESTIONS

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. Is actual discharge is less than theoretical discharge? Why?
2. What is the difference between actual discharge and theoretical discharge?
3. By constant head method what do you find out from Orifice?
4. What can you find out by using calipers ?
5. Which rise should taken for the calculation?
6. How do you take the water level in the tank?
7. what can you find with this experiment?
8. what is coefficient of discharge?
9. what is Orifice?
10. what is the difference between orifice and mouthpiece?

2.1.2 Determination of Coefficient of Discharge of an Orifice by Variable headmethod

OBJECTIVE

To perform variable head method for a small orifice to determine coefficient of discharge.

EQUIPMENT/APPARATUS/RESOURCES

Flow through orifice equipment, Meter scale, stop watch, Vernier Calipers.

1. TASK ANALYSIS

A.KNOWLEDGE

- Operating valves
- Usage of stopwatch
- Usage of Vernier calipers
- Reading values on piezometer
- Unit conversions

B.SKILLS

Category of Skill	Sub task
1. Handling of apparatus	• Using Vernier calipers to measure the diameter of Orifice. • Priming the motor before switching on.
2. Manipulation of apparatus	• Measure dimensions of orifice tank • measure the diameter of Orifice using Vernier caliper • Switch on the Pump (If pump is not working go for Priming)
3. Precise operation /activity	• Record the time taken to descend the water level in the orifice tank from head $H_1$to head H_2.

2. TEACHING POINTS

S. No	Teaching points	Suggestive Duration (min.)
1.	Describe the flow through Orifice equipment	6
2.	Importance and applications	
3.	Conceptof Bernoulli's equation	4
4.	Method of collecting data with Orifice	
5.	Precautions	
	A. Procedural precautions • Care should be taken in adjusting the control valve. • Proper care should be taken in recording the readingsof piezometer to avoid parallax error.	5
	B. Safety precautions • Care should be taken while working with the apparatus that water should not fall on the electrical parts of the equipment.	
	Total	15

3. NEED AND SCOPE OF THE EXPERIMENT

An orifice is an opening made in the side or bottom of tank, having a closed perimeter, through which the fluid may be discharged. Orifice is used to measure the rate of flow of liquid. The apparatus is designed to measure the co-efficient of discharge of orifice. With the help of this apparatus the time required to empting the tank can also be determined.

4. PLANNING AND ORGANIZATION

Action	Activity
Check for	1. Working condition of pump and valves. 2. Working condition of Stop watch. 3. Availability of sufficient quantity of water in the sump. 4. Over flow of orifice tank 5. More head difference may be taken for getting acceptable results
For design of Instruction	Read the teaching points carefully.

5. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub Task</th><th>Weight with competency level individually</th><th>Awarded
(50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A. Fully open the control valve to avoid bursting of pipes.
B. Check condition of valves of tank.
C. Check for working of stop watch</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>4</td><td></td></tr><tr><td>B</td><td>4</td><td></td></tr><tr><td>C</td><td>2</td><td></td></tr><tr><td>Total</td><td>10</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation of apparatus</td><td>A. Measure dimensions of orifice tank
B. measure the diameter of Orifice using Vernier caliper
C. Switch on the Pump (If pump is not working go for Priming)</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>C</td><td>5</td><td></td></tr><tr><td>Total</td><td>15</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/Activity</td><td>A. Fill the orifice tank to required head h_1
B. Record the time taken to descend the water level in the orifice tank from head $H_1$to head H_2.
C. Calculate C_d of Orifice meter</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>4</td><td></td></tr><tr><td>B</td><td>8</td><td></td></tr><tr><td>C</td><td>8</td><td></td></tr><tr><td>Total</td><td>20</td><td></td></tr></table></td><td></td></tr>
<tr><td>4. Values</td><td>A. Co-operation
B. Co-ordination
C. Communication
D. Sharing
E. Leadership</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A to E</td><td>5</td><td></td></tr></table></td><td></td></tr>
<tr><td colspan="2">Total</td><td>50</td><td></td></tr>
</table>

6. ASSESSMENT QUESTIONS(Only suggestive)

1. lower level
    a. Measuring the dimensions of the Orifice tank
    b. Measuring the diameter of the orifice.
    c. What precautions do you take to avoid the over flow of orifice tank?

2. Medium level
    a. How do you operate stop watch for taking time required for descending specified height of water in orifice tank?
    b. How do you convert the units from cm^3/s to m^3/s.
3. Difficult level
    a. How do you maintaining constant head in Piezometer?
    b. How do you prepare the graph with the calculated values?
    c. How do you draw a trend line and calculating of its slope?
    d. How do you calculate the Cd from graph?

7. VIVA QUESTIONS

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. Why discharge is differentiated as actual, theoretical?
2. Why Bernoulli's equation is used in this experiment?
3. Mention the precautions for this experiment?
4. What is the significance of head of water?
5. Is there any limit for C_d? What is the max value of Coefficient of discharge? Explain?
6. On what basis the orifices are classified?
7. How would you determine C_d from the graph $\sqrt{H_1} - \sqrt{H_2}$ to T ?

2.1.3 Determination of Co-efficient of Contraction of orifice by finding C_V & C_d

OBJECTIVE

To perform constant head method for a small orifice to determine the coefficient of contraction (Cc).

EQUIPMENT/APPARATUS/ RESOURCES

1. Flow through orifice equipment
2. Point gauge for measuring jet trajectory in x & y direction
3. Stop watch
4. Collecting tank fitted with piezometer
5. Vernier calipers

1. TASK ANALYSIS

A.KNOWLEDGE

- Definitions and relationship between C_d ,C_V and C_c
- Definition of Head and difference between constant head and variable head
- Properties of Jet propulsion
- Usage of point gauge(Vernier scale in x & y direction)
- Operation of stop watch
- Operation of different valves in the orifice equipment.
- Reading a piezometer values without parallax
- Use of Vernier callipers

B.SKILLS

Category of Skills	Sub task
1. Handling of apparatus	• Switching on the motor after priming • Operation of different valves • Using Verniercallipers to measure diameter of Orifice. • Measuring the internal dimensions of the tank. • Operation of stop watch • Operation of sliding Vernier scale
2. Manipulation of Apparatus	• Reading a piezometer values without parallax • Maintaining the constant head • Noting the time for collecting specified quantity of water and subsequent valve operations.

3. PreciseOperation/activity	• Reading on piezometer has to be taken corresponding to lower meniscus level. • Identifying the location of Vena-Contracta. • Noting down the Initial co-ordinates taken at vena-contracta and final co-ordinates taken at any random point on jet.

2. TEACHING POINTS

S. No	Teaching points	Suggestive Duration(min)
1.	What is meant by hydraulicCoefficients and types of hydraulic Coefficients	8
2.	Importance and practical application of finding thehydraulic Coefficients	
3.	Relationship between the hydraulic coefficients	
4.	Properties of Jet and Vena - contracta.	
5.	Demonstration of test	10
6.	***Precautions:*** ` • Care should be taken to check the overflow of collecting tank and orifice tank while the equipment is in running condition. • Do not open or close any valve, switch, etc while the functioning of the equipment.	2

3. NEED AND SCOPE OF THE EXPERIMENT

1. To determine the hydraulic coefficients for the given orifice equipment.
2. For selection of appropriate size of the pipes and other pipe specialsfor conveyance of liquids.

4. PLANNING AND ORGANIZATION

Action	Activity
Check for	• Availability of Water in sump for maintaining required heads • smooth movement ofPointer gaugeand proper alignment of Vernier • Working conditions of motor and stopwatch.
For design of instruction	• Read teaching points carefully

5. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub task</th><th>Weight with competency level individually</th><th>Awarded (50)</th></tr>
<tr><td>1.Handling of apparatus</td><td>A. Operation of valves
B. Using Verniercallipers to know diameter of Orifice& Measuring the collecting tank dimensions
C. Taking the reading of pointer gauge at different points</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>3</td><td></td></tr><tr><td>B</td><td>3</td><td></td></tr><tr><td>C</td><td>4</td><td></td></tr><tr><td>Total</td><td>10</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation Of Apparatus</td><td>A. Reading a piezometer values without parallax.
B. Maintaining constant head</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>10</td><td></td></tr><tr><td>Total</td><td>15</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/ activity</td><td>A. Position of Vena-Contracta should be found accurately.
B. Measuring the initial and final coordinates along jet trajectory.</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>10</td><td></td></tr><tr><td>B</td><td>10</td><td></td></tr><tr><td>Total</td><td>20</td><td></td></tr></table></td><td></td></tr>
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<tr><td></td><td>Total</td><td>50</td><td></td></tr>
</table>

6. Assessment Questions (Only suggestive)

1. lower level
    a. Measure the dimensions of the collecting tankof orifice apparatus?
    b. Measure the diameter of the orificein orifice apparatus?
    c. What precautions do you take to avoid the over flow of collecting tank and orifice tankin orifice apparatus?
2. Medium level
    a. How do you read the stop watch for taking time required for collecting specific height of water in collecting tankin orifice apparatus?

b. How do you convert the units from cm^3/s to m^3/s.

3. Difficult level
    a. How do you maintaining constant head in Piezometer in orifice apparatus?
    b. What are the precautions to be taken while taking the reading on the jet trajectory?
    c. How do you prepare the graph with the calculated valuesin orifice apparatus?
    d. How do you draw a trend line for the set of values plotted in graph and how you calculate of its slopein orifice apparatus?
    e. How do you calculate the Cd from graph?

7. Viva Questions

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. What is meant by an orifice? If water is not flowing fully, Will it still called as an orifice?
2. Distinguish between large and small orifice.
3. Why actual discharge is always less than theoreticaldischarge?
4. Why the C_d of the orifice is always less than that of mouthpiece?
5. What is meant by Vena-Contracta? Where it is formed?
6. What do you infer from the result?

2.1.4 MOUTHPIECE

OBJECTIVE

To perform constant head method of mouthpiece to determine the coefficient of discharge C_d.

EQUIPMENT/APPARATUS/RESOURCES

1. Mouth piece fitted to a balancing tank
2. Piezometer
3. Meter scale
4. Stopwatch
5. Collecting tank
6. Vernier calipers

1. TASK ANALYSIS

A.KNOWLEDGE

- What is mouthpiece
- Types of mouthpieces
- Application of mouthpiece
- What is coefficient of discharge
- Value of C_d for mouthpiece
- Unit conversions

B.SKILLS

Category of Skill	Sub task
1. Handling of Instrument	• Use meter scale to measure dimensions of collecting tank and recording its dimensions. • Use vernier calipers to know diameter of mouthpiece • Use stop watch to know time required to constant rise of water in collecting tank.
2. Manipulation of apparatus	• Operate outlet valve to know the rise of water in collecting tank. • Operate inlet valve to maintain constant head • Measure time required to constant rise in collecting tank after closing outlet valve
3. Precise operation /activity	• Record values accurately • Convert all measurements into single unit • Calculate Cd for mouth piece. • Plot the graph with specific parameters • Compare graph with standard values

2. TEACHING POINTS

S. No	Teaching points	Suggestive Duration (min.)
1.	Description about mouth piece A. Importance of Mouthpiece B. Types of Mouthpiece C. Applications of Mouth piece	5
2.	What is Cd	
3.	Standard Cd value for mouth piece	
4.	Methods of finding out coefficient of discharge for mouth piece	4
5.	Calculating actual discharge and theoretical discharge	6
6.	Calculating Cd	
7.	Precautions	
	A. Procedural precautions • Care should be taken in operating valves. • Time should be noted very carefully and accurately. • Proper care should be taken in recording the reading and calculating the Cd • Priming should be done before operating instrument • Water should not overflow from collecting tank.	
	Total	15

3. NEED AND SCOPE OF THE EXPERIMENT

COEFFICIENT OF DISCHARGE:

This parameter is useful for determining the irrecoverable losses associated with a certain piece of equipment in a fluid system, or the resistance that piece of equipment imposes upon the flow.

This flow resistance often expressed as a dimensionless parameter.

MOUTHPIECE

All openings cannot be considered as a mouthpiece unless the water level on the upstream side is above the opening. The purpose of the mouthpiece is to measure the discharge. Mouth piece is used where water surface is exposed to the atmosphere.By fitting the mouthpiece,the discharge through an orifice of the tank can be increased.

4. PLANNING AND ORGANIZATION

Action	Activity
Check for	1. Working condition of motor and stopwatch. 2. Functioning of valves. 3. Availability of quality & sufficient quantity of water. 4. Marked reading on piezometer
For design of Instruction	Read the teaching points carefully.

5. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub Task</th><th>Weight with competency level individually</th><th>Awarded
(50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A. Use meter scale to measure dimensions of collecting tank and recording its dimensions.
B. Use Vernier calipers to know diameter of mouthpiece</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>3</td><td></td></tr><tr><td>B</td><td>4</td><td></td></tr><tr><td>Total</td><td>7</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation of apparatus</td><td>A. Operate outlet valve to know the rise of water in collecting tank.
B. Operate inlet valve to maintain constant head
C. Measure time required to constant rise in collecting tank after closing outlet valve</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>6</td><td></td></tr><tr><td>C</td><td>7</td><td></td></tr><tr><td>Total</td><td>18</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/Activity</td><td>A. Convert all measurements into single unit
B. Calculate Cd for mouth piece.
C. Plot the graph with specific parameters
D. Compare graph with standard values</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>6</td><td></td></tr><tr><td>C</td><td>6</td><td></td></tr><tr><td>D</td><td>3</td><td></td></tr><tr><td>Total</td><td>20</td><td></td></tr></table></td><td></td></tr>
<tr><td>4. Values</td><td>A. Co-operation
B. Co-ordination
C. Communication
D. Sharing
E. Leadership</td><td><table><tr><td></td></tr><tr><td>5</td></tr></table></td><td></td></tr>
<tr><td colspan="2">Total</td><td>50</td><td></td></tr>
</table>

6. ASSESSMENT QUESTIONS(Only suggestive)

1. lower level
    a. Measure the dimensions of the collecting tank in mouth piece apparatus?
    b. Measure the diameter of the mouth piece apparatus?
    c. What precautions do you take to avoid the over flow of collecting tank?

2. Medium level
    a. How do you operate stop watch for taking time required for collecting specified height of water in collecting tank?
    b. How do you convert the units from cm^3/s to m^3/s.
3. Difficult level
    a. How do you maintain constant head in Piezometer in mouth piece apparatus?
    b. How do you prepare the graph with the calculated values in mouth piece apparatus?
    c. How do you draw a trend line and how you find its slope?
    d. How do you calculate the Cd from graph in mouth piece apparatus?

7. VIVA QUESTIONS

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. How can actual discharge can be calculated?
2. What is the difference between actual discharge and theoretical discharge?
3. By constant head method what do you find out from mouthpiece?
4. What can you find out by using calipers?
5. Which rise should taken for the calculation?
6. Which tank is connected to piezometer?
7. What can you find with this experiment?
8. What is coefficient of discharge?
9. What is mouthpiece?
10. What is the difference between orifice and mouthpiece?

2.1.5 RECTANGULAR NOTCH

OBJECTIVE

To perform Rectangular Notch experiment for determining the Coefficient of Discharge.

EQUIPMENT/APPARATUS/RESOURCES

1. Channel or Flume
2. Rectangular Notch
3. Hook gauge which consists of a sharply pointed needle
4. Stop watch
5. Piezometer fitted to collecting Tank
6. Meter scale

1. TASK ANALYSIS

A.KNOWLEDGE

- Actual discharge through Notch
- Theoretical discharge
- Head of water flow over bottom edge or crest of notch
- Regulate the water flow
- Use of stop watch
- Piezometer readings without parallax error
- Difference between Actual discharge and Theoretical discharge
- Need of Cd value to find out actual discharge at field channels

The head of water over the crest is useful to measure the discharge

B.SKILLS

Category of Skill	Sub task
1. Handling of apparatus	• Measure the size of Notch and collecting tank • Fitting of hook gauge with sharp edge needlein the notch tank. • Operation of stop watch.
2. Manipulation of apparatus	• Note the least count of point gauge • Allow the water in to notch tank up to crest level of notch and record the point gauge reading. • Control of Valves to regulate the flow • The head over Notch measured
3. Precise operation /activity	• Regulate the flow of water to maintain constant depth over crest of notch by control valve. • Measure the depth of flow • Note the time using the stop watch for 10cm rise of water in collecting tank • Readings of Piezometer without parallax error at collecting tank.

2. TEACHING POINTS

S. No	Teaching points	Suggestive Duration (min.)
1.	Need of conduct of laboratory experiment over Notches	5
2.	Need of find out coefficient discharge of Notch in laboratory	
3.	How to get the Actual discharge from Theoretical discharge by using 'Cd' value for field channels	
4.	Laboratory procedure to find the coefficient of discharge by conducting no-of trails	4
5.	Different types of Notches to find 'Cd' value	
6.	Explains the head of water and uniform flow of water above crest	
7.	How to regulate the water flow over Notch using control valves	6
9.	How to take readings of collecting tank piezometer withoutparallax and operation of stopwatch	
10.	Precautions	
	A. Procedural precautions • Care should be taken in measurement of notch sizes and collecting tanks • The experiment should be conducted only water is flowing uniformly above the crest. • The parallax error to avoided while taking readings in point gauge and piezometer tube • The gauge reading is read when tip of the gauge just touches the water surface • No leakages at any regulating valves. • The outlet of collecting tank must be firmly closed while taking readings	
	B. Safety precautions • Entire water circulation in apparatus with electrical motor and chance to get electrical shock • Don't wear metal ornaments. • Wear Helmet and shoes • Cheek the electrical wiring properly	
	Total	15

3. NEED AND SCOPE OF THE EXPERIMENT

COEFFICIENT OF DISCHARGE

Rectangular-notch is generally used to **measure** flow rate in an **open** channel flow. In real life applications it is used for seepage measurement of dam in foundation, inspection and top galleries and toe-drains in reservoirs. It has limited use in waste water and laboratories.

4. PLANNING AND ORGANIZATION

Action	Activity
Check for	1. Fixation of Notch plates 2. Working of motor and pump 3. Availability of sufficient quantity of water 4. Availability of stop watch 5. Function control valves 6. Leakages of tanks and valves
For design of Instruction	Read the teaching points carefully.

5. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub Task</th><th>Weight with competency level individually</th><th>Awarded (50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A. Measure sill width (b) of notch and dimensions of collecting tank.
B. Fitting of hook gauge with shape edge needle to notchtank</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>Total</td><td>10</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation of apparatus</td><td>A. Allow the water in to notch tank up to crest level of notch and record the point gauge reading.
B. Control of Valves to regulate the flow
C. The head over notch measured.</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>C</td><td>5</td><td></td></tr><tr><td>Total</td><td>15</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/Activity</td><td>A. Regulate the flow of water to maintain constant depth over crest of notch by control valve
B. Measure the depth of flow
C. Note the time using the stop watch for 10cm rise of water in collecting tank</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>10</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>C</td><td>5</td><td></td></tr><tr><td>Total</td><td>20</td><td></td></tr></table></td><td></td></tr>
<tr><td>4. Values</td><td>A. Co-operation
B. Co-ordination
C. Communication
D. Sharing
E. Leadership</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A to E</td><td>5</td><td></td></tr><tr><td>Total</td><td>5</td><td></td></tr></table></td><td></td></tr>
<tr><td></td><td>TOTAL</td><td>50</td><td></td></tr>
</table>

6. ASSESSMENT QUESTIONS(Only suggestive)

1. Lower level
   a. Noting the collecting tank dimensions
   b. Noting the sill level gauge reading
   c. Noting the width of the rectangular notch.
2. Medium level
   a. Noting the time taken for specified rise of water level in collecting tank.
   b. Coinciding the gauge tip with water level
3. Difficult level
   a. Noting the gauge readings without parallax
   b. Maintaining the constant head in balancing tank.

7. VIVA QUESTIONS

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. Why do you calculate coefficient discharge?
2. What is the difference between actual and Theoretical discharge?
3. What is the range of 'Cd' value?
4. What is difference between V-notch and Rectangular Notch?
5. How to maintain the constant head above crest of Notch
6. How to observe readings in peizometer?
7. What are applications of the Notch?

2.1.6 a TRIANGULAR NOTCH

OBJECTIVE

To perform Triangular Notch experiment to determine the Coefficient of Discharge.

EQUIPMENT/APPARATUS/RESOURCES

1. Channel or Flume
2. Triangular Notch
3. Hook gauge which consists of a sharply pointed needle
4. Stop watch
5. Piezometer fitted to collecting Tank
6. Meter scale
7. Protractor

1. TASK ANALYSIS

A.KNOWLEDGE

- Actual discharge through Notch
- Theoretical discharge
- Head of water flow over bottom edge or crest of notch
- Regulate the water flow
- Use of stop watch
- Piezometer readings without parallax error
- Difference between Actual discharge and Theoretical discharge
- Need of Cd value to find out actual discharge at field channels

The head of water over the crest is useful to measure the discharge

B.SKILLS

Category of Skill	Sub task
1. Handling of apparatus	• Measure the size of Notch. and collecting tank • Fitting of hook gauge with sharp edge needle Notch tank. • Operation of stop watch.
2. Manipulation of apparatus	• Note the least count of point gauge • Allow the water in to notch tank up to crest level of notch and record the point gauge reading. • Control of Valves to regulate the flow • The head over Notch measured
3. Precise operation /activity	• Regulate the flow of water to maintain constant depth over crest of notch by control valve. • Measure the depth of flow • Note the time using the stop watch for 10cm rise of water in collecting tank • Readings of Piezometer without parallax error at collecting tank.

2. TEACHING POINTS

S. No	Teaching points	Suggestive Duration (min.)
1.	Need of conduct of laboratory experiment over Notches	5
2.	Need of find out coefficient discharge of Notch in laboratory	
3.	How to get the Actual discharge from Theoretical discharge by using 'Cd' value for field channels	
4.	Laboratory procedure to find the coefficient of discharge by conducting no-of trails	4
5.	Different types of Notches to find 'Cd' value	
6.	Explains the head of water and uniform flow of water above crest	
7.	How to regulate the water flow over Notch using control valves	6
9.	How to take readings of collecting tank piezometer withoutparallax and operation of stopwatch	
10.	Precautions	
	A. Procedural precautions • Care should be taken in measurement of notch sizes and collecting tanks • The experiment should be conducted only water is flowing uniformly above the crest. • The parallax error to avoided while taking readings in point gauge and piezometer tube • The gauge reading is read when tip of the gauge just touches the water surface • No leakages at any regulating valves. • The outlet of collecting tank must be firmly closed while taking readings	
	B. Safety precautions • Entire water circulation in apparatus with electrical motor and chance to get electrical shock • Don't wear metal ornaments. • Wear Helmet and shoes • Cheek the electrical wiring properly	
	Total	15

3. NEED AND SCOPE OF THE EXPERIMENT

COEFFICIENT OF DISCHARGE

The Weirs and Notches are used to find out discharge of water in field channels. The notch is "V" in shape. Depth of water above the bottom of the V (tip of the Notch) is called head (H). The V-notch design causes small changes in discharge hence causing a large change in depth and thus allowing more accurate measurement than with a rectangular notch.

V-notch is generally used to measure flow rate in an open channel flow. In real life applications it is used for seepage measurement of dam in foundation, inspection and drainage galleries and toe-drains in reservoirs. It has limited use in waste water and laboratories.

4. PLANNING AND ORGANIZATION

Action	Activity
Check for	1. Fixation of Notch plates 2. Working of motor and pump 3. Availability of sufficient quantity of water 4. Availability of stop watch 5. Function control valves 6. Leakages of tanks and valves
For design of Instruction	Read the teaching points carefully.

5. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub Task</th><th>Weight with competency level individually</th><th>Awarded
(50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A. Measure size of Notch and collecting tanks.
B. Fitting of hook gauge with shape edge needleto notch tank</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>Total</td><td>10</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation of apparatus</td><td>A. Allow the water in to notch tank up to crest level of notch and record the point gauge reading.
B. Control of Valves to regulate the flow
C. The head over Notch measured</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>C</td><td>5</td><td></td></tr><tr><td>Total</td><td>15</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/Activity</td><td>A. Regulate the flow of water to maintain constant depth over crest of notch by control valve
B. Measure the depth of flow
C. Note the time using the stop watch for 10cm rise of water in collecting tank</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>6</td><td></td></tr><tr><td>B</td><td>7</td><td></td></tr><tr><td>C</td><td>7</td><td></td></tr><tr><td>Total</td><td>15</td><td></td></tr></table></td><td></td></tr>
<tr><td>4. Values</td><td>A. Co-operation
B. Co-ordination
C. Communication
D. Sharing
E. Leadership</td><td><table><tr><td></td></tr><tr><td>5</td></tr></table></td><td></td></tr>
<tr><td></td><td>TOTAL</td><td>50</td><td></td></tr>
</table>

6. ASSESSMENT QUESTIONS(Only suggestive)

1. Lower level
   a. Noting the collecting tank dimensions
   b. Noting the sill level gauge reading
   c. Noting the angle of V- notch.
2. Medium level
   a. Noting the time taken for specific rise of water level in collecting tank.
   b. Coinciding the gauge tip with water level
3. Difficult level
   a. Noting the gauge readings without parallax
   b. Maintaining the constant head in balancing tank.

7. VIVA QUESTIONS

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. Why do you calculate coefficient discharge?
2. What is the difference between actual and Theoretical discharge?
3. What is the range of 'Cd' value?
4. What is difference between V-notch and Rectangular Notch?
5. How to maintain the constant head above crest of Notch
6. How to observe readings in peizometer?
7. What are applications of the Notch?

2.1.6 b TRAPEZOIDAL NOTCH

OBJECTIVE

To determine the Coefficient of Discharge of a Trapezoidal Notch

EQUIPMENT/APPARATUS/RESOURCES

1. Channel or Flume
2. Trapezoidal Notch
3. Hook gauge which consists of a sharply pointed needle
4. Stop watch
5. Piezometer fitted to collecting Tank
6. Meter scale
7. Protractor

1. TASK ANALYSIS

A.KNOWLEDGE

- Actual discharge through Notch
- Theoretical discharge
- Head of water over the bottom edge or crest of the notch
- Regulate the water flow
- Use of stop watch
- Piezometer readings without parallax error
- Difference between Actual discharge and Theoretical discharge
- Need of Cd value to find out actual discharge at field channels

The head of water over the crest is useful to measure the discharge

B.SKILLS

Category of Skill	Sub task
1. Handling of apparatus	• Measure thesize of Notch and collecting tank • Fitting of hook gauge with sharp edge needle over Notch tank. • Operation of stop watch.
2. Manipulation of apparatus	• Note the least count of point gauge • Allow the water in to notch tank up to crest level of notch and record the point gauge reading. • Control of Valves to regulate the flow • The head over the crest or sill of the Notch is measured
3. Precise operation /activity	• Regulate the flow of water to maintain constant depth over crest of notch by control valve. • Measure the depth of flow • Note the time using the stop watch for 10cm rise of water in collecting tank • Readings of Piezometer without parallax error at collecting tank.

2. TEACHING POINTS

S. No	Teaching points	Suggestive Duration (min.)
1.	Need of conduct of laboratory experiment over Notches	5
2.	Need of find out coefficient discharge of Notch in laboratory	
3.	How to get the Actual discharge from Theoretical discharge by using 'Cd' value for field channels	
4.	Laboratory procedure to find the coefficient of discharge by conducting no-of trails	4
5.	Different types of Notches to find 'Cd' value	
6.	Explains the head of water and uniform flow of water above crest	
7.	How to regulate the water flow over Notch using control valves	6
9.	How to take readings of collecting tank piezometer withoutparallax and operation of stopwatch	
10.	Precautions	
	A. Procedural precautions • Care should be taken in measurement of notch sizes and collecting tanks • The experiment should be conducted only water is flowing uniformly above the crest. • The parallax error to avoided while taking readings in point gauge and piezometer tube • The gauge reading is read when tip of the gauge just touches the water surface • No leakages at any regulating valves. • The outlet of collecting tank must be firmly closed while taking readings	
	B. Safety precautions • Entire water circulation in apparatus with electrical motor and chance to get electrical shock • Don't wear metal ornaments. • Wear Helmet and shoes • Cheek the electrical wiring properly	
	Total	15

3. NEED AND SCOPE OF THE EXPERIMENT

COEFFICIENT OF DISCHARGE

Trapezoidal-notch is generally used to **measure** flow rate in an **open** channel flow. In real life applications it is used for seepage measurement of dam in foundation, inspection and top galleries and toe-drains in reservoirs. It has limited use in waste water and laboratories.

4. PLANNING AND ORGANIZATION

Action	Activity
Check for	1. Fixation of Notch plates 2. Working of motor and pump 3. Availability of sufficient quantity of water 4. Availability of stop watch 5. Functioning of control valves 6. Leakages of tanks and valves
For design of Instruction	Read the teaching points carefully.

5. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub Task</th><th>Weight with competency level individually</th><th>Awarded (50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A. Measure size of Notch and collecting tanks.
B. Fitting of hook gauge with sharp edge needleto notch tank</td><td><table><tr><td>Skill</td><td>Max</td><td>Awarded</td></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>Total</td><td>10</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation of apparatus</td><td>A. Allow the water in to notch channelup to crest level of notch and record the point gauge reading.
B. Control of Valves to regulate the flow
C. The head over Notch measured</td><td><table><tr><td>Skill</td><td>Max</td><td>Awarded</td></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>C</td><td>5</td><td></td></tr><tr><td>Total</td><td>15</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/Activity</td><td>A. Regulate the flow of water to maintain constant depth over crest of notch by control valve
B. Measure the depth of flow
C. Note the time using the stop watch for 10cm rise of water in collecting tank</td><td><table><tr><td>Skill</td><td>Max</td><td>Awarded</td></tr><tr><td>A</td><td>6</td><td></td></tr><tr><td>B</td><td>7</td><td></td></tr><tr><td>C</td><td>7</td><td></td></tr><tr><td>Total</td><td>20</td><td></td></tr></table></td><td></td></tr>
<tr><td>4. Values</td><td>A. Co-operation
B. Co-ordination
C. Communication
D. Sharing
E. Leadership</td><td><table><tr><td></td></tr><tr><td>5</td></tr></table></td><td></td></tr>
<tr><td></td><td>TOTAL</td><td>50</td><td></td></tr>
</table>

6. ASSESSMENT QUESTIONS(Only suggestive)

1) Lower level
   a) Noting the collecting tank dimensions
   b) Noting the sill level gauge reading
   c) Noting the width and side slopes of the trapezoidal notch.
2) Medium level
   a) Noting the time taken for specific rise of water level in collecting tank.
   b) Coinciding the gauge tip with water level
3) Difficult level
   a) Noting the gauge readings without parallax
   b) Maintaining the constant head in balancing tank.

7. VIVA QUESTIONS

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. Why do you calculate coefficient discharge?
2. What is the difference between actual and Theoretical discharge?
3. What is the range of 'Cd' value?
4. What is difference between V-notch, Rectangular Notch and Trapezoidal notch?
5. How to maintain the constant head above crest of Notch
6. How to observe readings in peizometer?
7. What are applications of Notch?

2.1.7 VERIFICATION OF BERNOULLI'S THEOREM

OBJECTIVE

To verify the Bernoulli's Theorem

EQUIPMENT/APPARATUS/RESOURCES

1. Bernoulli's apparatus,
   (Inlet tank, collecting tank and piezometers)
2. Stop watch,
3. Meter Scale.

1. TASK ANALYSIS

A.KNOWLEDGE

- Definition of Bernoulli's Principle.
- Knowledge on Pressure head, velocity head and datum head.
- Measurement of piezometer reading.
- Controlling of flow using valves.
- Recording of time.

B.SKILLS

Category of Skill	Sub task
1. Handling of apparatus	• Priming operation. • Stop watch reading. • Controlling of flow rate by operating valves.
2. Manipulation of apparatus	• Maintaining of constant head by valves • Measurement of areas and piezometer reading at given sections without parallax. • Measurement of collecting tank. • Note down the time taken for 10 cm rise in collecting tank without parallax
3. Precise operation /activity	• Calculation of actual discharge • Calculation of velocity and velocity heads at various sections of piezometers. • Calculation and verification of total heads at various sections.

2. TEACHING POINTS

S. No	Teaching points	Suggestive Duration (min.)
1.	Importance of Bernoulli's theorem.	5
2.	Explanation of Bernoulli's theorem through Law of conservation of Energy.	
3.	Assumptions made in derivation of Bernoulli's theorem	
4.	Limitations of Bernoulli's theorem	4
5.	Applications of Bernoulli theorem	
6.	Explanation of pressure head, kinetic head and datum head	
7.	Variation of heads in a tapered pipe and the total head.	6
8.	Examples based on Bernoulli's theorem	
9	Solving of problems using Bernoulli's theorem	
10	Precautions	
	A. Procedural precautions • Care should be taken while maintaining the constant head throughout the experiment is conducted. • caresholuld be taken while taking piezometer readings. • Proper care should be taken while taking time "t" for collection of water to the known rise in the collecting tank.	
	B. Safety precautions • Care should be taken to not spitting of water on motor while motor running.	
	Total	15

3. NEED AND SCOPE OF THE EXPERIMENT

BERNOULLI'S THEOREM

Bernoulli's theorem is the principle of energy conservation for ideal fluids in steady flow and is the basis for many engineering applications.Bernoulli's theorem gives the solution for many hydraulic problems like finding of discharge through a pipe flow, channel flow and losses in flows.

4. PLANNING AND ORGANIZATION

Action	Activity
Check for	1. Priming of pump. 2. Working condition of electric motor. 3. Whether the valves are open or closed. 4. There is no air bubbles in the piezometers.
For design of Instruction	Read the teaching points carefully.

5. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub Task</th><th>Weight with competency level individually</th><th>Awarded (50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A. Performance of Priming operation
B. Controlling of flow rate by operating valves</td><td><table><tr><td>Skill</td><td>Max</td><td>Awarded</td></tr><tr><td>A</td><td>3</td><td></td></tr><tr><td>B</td><td>3</td><td></td></tr><tr><td>Total</td><td>6</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation of apparatus</td><td>A. Maintaining constant level by operating valves
B. Measurement of piezometer reading at given sections without parallax
C. Note down the time taken for 10 cm rise in collecting tank without parallax</td><td><table><tr><td>Skill</td><td>Max</td><td>Awarded</td></tr><tr><td>A</td><td>7</td><td></td></tr><tr><td>B</td><td>6</td><td></td></tr><tr><td>C</td><td>6</td><td></td></tr><tr><td>Total</td><td>19</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/Activity</td><td>A. Calculation of areas and actual discharge
B. Calculation of velocity and velocity heads at various sections of piezometers.
C. Calculation and verification of total heads at various sections.</td><td><table><tr><td>Skill</td><td>Max</td><td>Awarded</td></tr><tr><td>A</td><td>6</td><td></td></tr><tr><td>B</td><td>7</td><td></td></tr><tr><td>C</td><td>7</td><td></td></tr><tr><td>Total</td><td>20</td><td></td></tr></table></td><td></td></tr>
<tr><td>4. Values</td><td>A. Co-operation
B. Co-ordination
C. Communication
D. Sharing
E. Leadership</td><td><table><tr><td></td></tr><tr><td>5</td></tr></table></td><td></td></tr>
<tr><td colspan="2">Total</td><td>50</td><td></td></tr>
</table>

6. ASSESSMENT QUESTIONS(Only suggestive)

1. Lower level
    a. Noting the area of collecting tank
    b. Noting the diameters of pipe at different point where piezometers are connected
2. Medium level
    a. Accurately measuring the different piezometer readings
    b. Noting the time required for specific rise in water level in collecting tank
3. Difficult level
    a. Maintaining the constant head in balancing tank
    b. Measuring the total heads at different piezometer points.

7. VIVA QUESTIONS

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. Why do you maintain constant head?
2. What are the heads available in a flowing fluid?
3. Define principle of Bernoulli's theorem?
4. Why the conduit is tapered section?
5. What type of head is measured in piezometer?
6. How do you find the velocity of flow at a section?
7. What is velocity head, datum head?
8. Write down the equation for Bernoulli's theorem?
9. What are the applications of Bernoulli's theorem?
10. What is your inference after verification of Bernoulli's theorem?

2.1.8 Determination of Coefficient of Discharge for Venturimeter.

OBJECTIVE

To perform venturimeter experiment to determine the Coefficient of discharge.

EQUIPMENT/APPARATUS/RESOURCES

- A closed circuit Venturimeter apparatus
- U tube manometer
- Collecting tank fitted withpiezometer
- Meter scale
- Stop watch.

2. TASK ANALYSIS

A.KNOWLEDGE

- Description of venturimeter.
- Venturi effect.
- Definition of discharge, total energy
- Equation of continuity
- Differential U-tube manometer.
- Coefficient of discharge.

B.SKILLS

Category of Skill	Sub task
1. Handling of apparatus	• Operate the control valve for varying flow rate. • Check condition of valves for manometer, collecting tank, venturimeter conduit or pipe. • Check for working of stop watch and Pump (If pump is not working go for Priming) .
2. Manipulation of apparatus	• Release air bubbles in U tube manometer by using respective valves. • Release valves of collecting tank, noting the time taken for specific rise in water level in it.
3. Precise operation /activity	• Adjust control valve for required flow rate • Record readings of u tube manometer. • Calculate C_d of venturi meter

3. TEACHING POINTS

S. No	Teaching points	Suggestive Duration (min.)
1.	Description of venturimeter	5
2.	Importance and applications	
3.	Concept of Continuity equation, Bernoulli's equation	4
4.	Method of collecting data from venturimeter	
5	Precautions	6
	A. Procedural precautions • Care should be taken in adjusting the control valve. • U tube manometer valve are adjusted carefully otherwise there will be chance of spilling off manometric fluid(mercury) • Proper care should be taken in recording the readingsof piezo meter and manometer to avoid parallax error. • After taking collecting the time required to fill the collecting tank, the valve must be opened to avoid over flowing of water.	
	B. Safety precautions • Care should be taken while working with the apparatus that water should not fall on the electrical parts of the equipment.	
	Total	15

4. NEED AND SCOPE OF THE EXPERIMENT

- Venturimeter can also called as a flow meter. The venturimeter helps to calculate discharge of a fluid flowing in a pipe by creating pressure difference between two points..
- Venturimeters are used in water and wastewater pipelines systems and treatment plants.
- The temperatures and pressures of fluids flowing in a pipeline do not affect the accuracy of Venturi meter, because of this they are used in crude oil pipelines for measuring discharge through it.
- Another advantage of using the Venturimeter in volatile and rigid environments is that, it has no moving parts; and there is no risk of them freezing and breaking due to thermal expansion.
- The venturi meter in carburetors is used to measure airflow in a car engine and to ensure that a correct amount of fuel is fed to the gas combustion engine when needed during driving. The air and fuel mixture must be evenly distributed to the engine in order for it to work properly.

5. PLANNING AND ORGANIZATION

Action	Activity
Check for	1. working condition of pump and valve 2. Working condition of stop watch 3. Availability of sufficient quantity of water in the sump
For design of Instruction	Read the teaching points carefully.

6. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub Task</th><th>Weight with competency level individually</th><th>Awarded
(50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A. Fully openthe control valve for varying flow rate.
B. Check condition of valves for manometer, collecting tank, venturimeter conduit or pipe.
C. Check for working of stop watch and Pump (If pump is not working go for Priming)</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>C</td><td>5</td><td></td></tr><tr><td>Total</td><td>15</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation of apparatus</td><td>A. Release air bubbles in U tube manometer by using respective valves.
B. Release valves of collecting tank</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>Total</td><td>10</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/Activity</td><td>A. Adjust control valve for required flow rate
B. Record readings of u tube manometer.
C. Record the time required to fill the collecting tank of required height.
D. Calculate C_d of venturimeter</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>C</td><td>5</td><td></td></tr><tr><td>D</td><td>5</td><td></td></tr><tr><td>Total</td><td>20</td><td></td></tr></table></td><td></td></tr>
<tr><td>4. Values</td><td>A. Co-operation
B. Co-ordination
C. Communication
D. Sharing
E. Leadership</td><td>5</td><td></td></tr>
<tr><td colspan="2">Total</td><td>50</td><td></td></tr>
</table>

7. ASSESSMENT QUESTIONS(Only suggestive)

1. lower level
    a. Noting the diameter of inlet and throat of venturimeter
    b. Calculating the area of collecting tank.
2. Medium level
    a. Noting the time required for specific rise in water level in collecting tank
    b. Noting the differential u tube manometer reading carefully
3. Difficult level
    a. Expelling the entrapped air in differential u tube manometer
    b. Maintaining the constant head in balancing tank

8. VIVA QUESTIONS

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. what are the factors effecting continuity equation?
2. Need for calculating Coefficient of discharge?
3. Why discharge is differentiated actual, theoretical?
4. Give Bernoulli's equation?
5. Give the precautions to be taken during this experiment?
6. What is the use of U tube manometer?
7. Is there any limit for Cd?
8. Give applications of Venturimeter?
9. How would you determine C_d from the graph Q_a and $\sqrt{h}$?

2.1.9 COEFFICIENT OF FRICTION OF A GIVEN PIPE

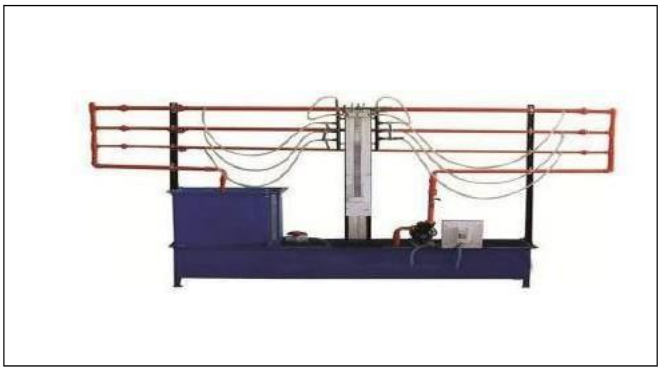
OBJECTIVE

To perform pipe friction experiment to determine the coefficient of friction.

EQUIPMENT/APPARATUS / RESOURCES

1. Friction factor apparatus with closed circuit and with centrifugal pump, over- head tank fitted with piezometer, collecting tank fitted with piezometer and pipes of different diameter.
2. U-Tube Manometer.
3. Vernier Callipers,
4. Measuring Scale,
5. Stop Watch.

.



1. TASK ANALYSIS

A.KNOWLEDGE

- Piezometric Head.
- .
- Theoretical Discharge.
- Actual Discharge.
- Pipe Flow. Frictional Effect, Factors effecting Friction.
- Darcy's-Weishbach Formula.

.

B.SKILLS

Category of Skill	Sub task
1. Handling of apparatus	• Use Vernier callipers to determine diameter of the pipe. • Perform Priming of Centrifugal Pump. • Identify the points in the pipe to know the Pressure difference
2. Manipulation of apparatus	• Regulate the flow in pipe to avoid air bubbles. • Operate Inlet Valve to Maintain Constant Head, • OperateControl valves for Reservoir and Collecting tank. • Operate Control valves for Creating Pressure Difference between two points.
3. Precise operation /activity	• Take Differential Manometer reading. • Measurement of 100mm rise in collecting tank. • Note the time for 100mm rise by stop watch in seconds.

2. TEACHING POINTS

S. No	Teaching points	Suggestive Duration (min.)
1.	Effectof friction on flow rate in Close conduit flow	9
2.	Factors affecting Friction	
3.	Standard Values of Coefficient of Friction of Different Pipe Materials as per BIS.	
4.	Types of Flow in Pipe.	
5.	Conversion of Manometric Pressure Difference in terms of Head of water.	6
6.	Actual Discharge and Theoretical Discharge.	
7.	Precautions	
	A. Procedural precautions • Care should be taken while taking the observations • Parallax errors should be minimised. • Proper care should be taken in maintaining Pressure difference as mercury spills out of Differential U-Tube manometer,	
	B. Safety precautions • Care should be taken while Switch on/Switch off the motor	
	Total	15

3. NEED AND SCOPE OF THE EXPERIMENT

PIPE FRICTION

FRICTION is the Resistance offered by the pipe material to the flow of liquid, and it depends upon the type of Pipe material.

Pipe Friction is an important parameter. It is often taken in determination of losses in pipes.

Pipe Friction is an indicative of

- Possible head loss in pipes.

.

On the other hand, Pipe Friction also depends upon on type of flow i.e, Laminar flow and turbulent flow .Various Scientists have developed different formulae to calculate Pipe Friction depending on type of surface of pipe i.e. Smooth Surface and Rough Surface. The most Prominent is Darcy-Weishbach Formula to calculate the coefficient of friction.

4. PLANNING AND ORGANIZATION

Action	Activity
Check for	1. Priming and Working condition of Centrifugal Pump. 2. Diameter of pipe. 3. Pressure Difference in U-tube Manometer. 4. Time taken for 10 Cm Rise.
For design of Instruction	Read the teaching points carefully.

5. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub Task</th><th>Weight with competency level individually</th><th>Awarded (50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A. Use Vernier calipers to determine Dia of pipe.
B. Identify the points in the pipe to know the Pressure difference.</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>Total</td><td>10</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation of apparatus</td><td>A. Regulate Valve to Maintain Constant Head.
B. Operate Control valves for Creating Pressure Difference between two points.
C. Operate Control valves for Reservoir and Collecting tank.</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>C</td><td>5</td><td></td></tr><tr><td>Total</td><td>15</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/Activity</td><td>A. Note Differential Manometer reading.
B. Measure 100 mm rise in collecting tank.
C. Note time for 100 mm rise by stop watch in seconds</td><td><table><tr><th>Skill</th><th>Max</th><th>Awarded</th></tr><tr><td>A</td><td>6</td><td></td></tr><tr><td>B</td><td>7</td><td></td></tr><tr><td>C</td><td>7</td><td></td></tr><tr><td>Total</td><td>20</td><td></td></tr></table></td><td></td></tr>
<tr><td>4. Values</td><td>A. Co-operation
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<tr><td colspan="2">Total</td><td>50</td><td></td></tr>
</table>

6. ASSESSMENT QUESTIONS(Only suggestive)

1. Lower level
    a. Identify the diameter of pipe and valves to be operated for measurement of differential pressure head.
    b. How do you measure the collecting tank dimensions
2. Medium level
    a. How do you note down the differential U tube manometer reading without parallax error.
    b. How do you measure the time taken for specified rise of water level in collecting tank
3. Difficult level
    a. What are the factors effecting loss of head in flow through pipes.
    b. What is the significance of friction coefficient in pipe flow?
    c. How do you operate different values to expel the air entrapped in the piezometeric tubes?

7. VIVA QUESTIONS

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. What do you mean by Friction?
2. State Practical applications of Friction?
3. Write the formula for Darcy's-Weishbach equation.
4. Why do you find out friction factor in pipes?
5. What are major losses in pipes?
6. List Different type of minor losses in pipes.
7. Mention different Formulae to determine friction factor in pipes.
8. How do you reduce the loses in pipe flow?

2.1.10 DETERMINATION OF CHEZY'S CONSTANT FROM FLOWTHROUGH OPEN CHANNEL

OBJECTIVE

To perform open channel experiment to determine chezy's constant.

EQUIPMENT/APPARATUS/RESOURCES

1. Open channel of rectangular cross section with slope adjusting mechanism.
2. Pointer gauge.
3. Measuring tank.
4. Stop watch.

1. TASK ANALYSIS

A.KNOWLEDGE

- Operating valves to maintain steady flow.
- Setting up the slope of the channel.
- Taking the water level reading using the Vernier scale.
- Dimensions of the open channel and collecting tank.
- Operating stop watch.
- Calculation of area of the channel, wetted perimeter and hydraulic radius.
- Understanding the discharge formulas (Q_{act} and Q_{th}).
- Calculation of actual and theoretical discharge of open channel flow.
- Drawing graphs with the calculated values, formation of trend line and calculation of Chezy's constant.

B.SKILLS

Category of Skill	Sub task
1. Handling of apparatus	• Before starting the motor priming should be done in necessary. • Operating valves to maintain steady flow. • Taking the water level reading using the gauge. Reading the piezometer without parallax error. • Stop watch operation. • Care should be taken such that to avoid overflow of the collecting tank.
2. Manipulation of apparatus	• Noting down the slope of the channel. • Maintaining steady flow. • Noting the time taken for 10cm rise in the collecting tank.
3. Precise operation /activity	• Head should be read carefully on the point gauge. • Calculating the values of chezy's constant for different discharges.

2. TEACHING POINTS

S. No	Teaching points	Suggestive Duration (min.)
1.	Introduction to open channel flow and explain its types.	6
2.	Explain about uniform and non-uniform, steady and unsteady, laminar and turbulent flow.	
3.	Explain the terms in open channel flow.	
4.	Explain the discharge (Q_{act} and Q_{th}) formula and its terms.	4
5.	Calculation of chezy's coefficient from discharge formula.	
6.	Reasons for incorrect range of chezy's constant.	5
7.	Precautions	
	A. Procedural precautions • Priming should be done before switch on the motor. • Proper care should be taken in the reading of head in the Vernier scale. • Care should be taken while considering level of water in tube when meniscus touches the bottom. • Care should be taken while operating the stop watch for 10cm rise of water level.	
	B. Safety precautions • Care should be taken while switch on the motor.	
	Total	15

3. NEED AND SCOPE OF THE EXPERIMENT

The chezy's constant depends on the surface roughnesses which influence the discharge in the open channel. By knowing the chezy's constant we can estimate the flood discharge in open channels and hydraulic structures like weirs, barrages, bridges etc.

Chezy's formula : $Q = AC\sqrt{(mi)}$

where Q =discharge
A = Area of Cross Section of flow
C = chezy's constant,
m = hydraulic radius or depth = (A/P)
i= Bed slope of the channel along its length

4. PLANNING AND ORGANIZATION

Action	Activity
Check for	1. Priming of the motor. 2. Setting the slope of the open channel. 3. Taking readings of heads
For design of Instruction	Read the teaching points carefully.

5. SCHEME OF EVALUATION

<table>
<tr><th>Category of skill</th><th>Sub Task</th><th>Weight with competency level individually</th><th>Awarded
(50)</th></tr>
<tr><td>1. Handling of apparatus</td><td>A. Setting the slope of the channel
B. operating valves to maintain steady flow</td><td><table><tr><td>Skill</td><td>Max</td><td>Awarded</td></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>Total</td><td>10</td><td></td></tr></table></td><td></td></tr>
<tr><td>2.Manipulation of apparatus</td><td>A. Reading the slope of the channel
B. Touching the tip of the guage with topsurface of the water level.
C. In collecting tank, Noting the time taken for 10cm rise in the piezometer.</td><td><table><tr><td>Skill</td><td>Max</td><td>Awarded</td></tr><tr><td>A</td><td>5</td><td></td></tr><tr><td>B</td><td>5</td><td></td></tr><tr><td>C</td><td>5</td><td></td></tr><tr><td>Total</td><td>15</td><td></td></tr></table></td><td></td></tr>
<tr><td>3.Precise Operation/Activity</td><td>A. Reading the guage after touching the water level in the flow.
B. Calculating hydraulic mean radius, velocity for the discharge
C. Calculating the values of chezy's constant for different discharges</td><td><table><tr><td>Skill</td><td>Max</td><td>Awarded</td></tr><tr><td>A</td><td>6</td><td></td></tr><tr><td>B</td><td>7</td><td></td></tr><tr><td>C</td><td>7</td><td></td></tr><tr><td>Total</td><td>20</td><td></td></tr></table></td><td></td></tr>
<tr><td>4. Values</td><td>A. Co-operation
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<tr><td colspan="2">Total</td><td>50</td><td></td></tr>
</table>

6. ASSESSMENT QUESTIONS(Only suggestive)

1. Lower level:
    a. How you change the slope of the channel
    b. How you measure the dimensions of the collecting tank
    c. When did you take the initial water level reading
2. Medium level
    a. How do you adjust the longitudinal bed slope of the channel to a particular value
    b. How you measure the time taken for specific rise of water level in the collecting tank.
    c. What is the significance of the chezy's constant in open channel flow.
3. Difficult level
    a. What precautions did you take while taking the reading on gauge when pointer touches the water level
    b. What is the need to take more than one reading of head of water in the open channel flow.

7. VIVA QUESTIONS

(Only suggestive. The teacher may add questions depending upon the Context of examination)

1. What is the need of priming?
2. Define a. uniform flow, b. non-uniform flow c. steady flow d. unsteady flow e. laminar flow f. turbulent flow
3. What is the difference between uniform and non-uniform flow?
4. What is the difference between steady and unsteady flow?
5. What is the difference between laminar and turbulent flow?
6. Where we use chezy's constant?
7. Which is accurate among chezy's or manning's formulae for calculating discharge?
8. What is the purpose of the chezy's constant?

3. WORK SHEETS

WORK SHEET

Name of the student:		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:

1. Title of the experiment: COEFFICENT OF DISCHARGE OF ORIFICE BY CONSTANT HEAD METHOD

2. Objective of the experiment: _____

_____

3. Apparatus/Tools required: _____

_____

4. PROCEDURE:

1)
2)
3)
4)
5)
6)
7)
8)

5. OBSERVATIONS:

Diameter of the orifice, d = cm

Plan Dimensions of collecting tank: L = cm

B = cm

S.No.	Head 'h' (cm)	Time for H=10cm rise of water level in collecting tank 'T' (sec)			$\sqrt{h}$	Discharge in (cm^3/sec)		Coefficient of Discharge $C_d=\frac{Qa}{Qth}$
		Trial		Average		$Q_a=\frac{AH}{T}$	$Q_{th}=a\sqrt{2gh}$	
		1	2	T (Sec)				
1								
2								
3								
4								
5								
6								
Mean Value of C_d =								

SPECIMENS CALCULATIONS (For Reading No.____)

)

Area of orifice, a = $\pi d^2/4$ = cm^2

Internal plan area of collecting tank, A = L× B= cm^2

Actual Discharge, Q_a = (AH/T) = cm^3/sec

Theoretical Discharge, $Q_{th}=a\sqrt{2gh}$ = cm^3/sec

Coefficient of Discharge, $C_d=\frac{Qa}{Qth}$ =

6. RESULT: _____

_____

7. INFERENCE: _____

_____

_____

_____

_____

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:

_____

_____

_____

9. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awarded (50)
1. Handling of apparatus	A. Using meter scale to measure dimensions of collecting tank and recording its dimensions. B. Using Vernier calipers to measure the diameter of Orifice. C. Priming the motor before switching on. D. Operating outlet valve of collecting tank for taking T & H for calculation of Qa, without overflowing it.	10	
2.Manipulation of Apparatus	A. Measure the time required (T) to rise the water level to a desired height (H) after closing outlet valve in the colleting tank. B. Convert all measurements into single unit.	15	
3.Precise Operation/Activity	A. Maintaining constant head in Piezometer. B. Preparation of graph with the calculated values and adding a trend line, measuring slope of it and finding out the Cd from graph.	20	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	5	
Total		50	

WORK SHEET

Name of the student:		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:

1. Title of the experiment: C_d of Orifice by falling head method

2. Objective of the experiment:

_____

_____

3. Apparatus/Tools required:

_____

_____

4. PROCEDURE:

1)
2)
3)
4)
5)
6)
7)
8)

5. OBSERVATIONS:

Diameter of orifice (d) = cm

Balancing tank (Orifice tank) plan dimensions (L X B) : L = cm

B= cm

S.No.	Head over the Orifice		Time (T) taken to fall head from H_1 to H_2 (sec)	$\sqrt{H1}$	$\sqrt{H2}$	$\sqrt{H1}-\sqrt{H2}$	Coefficient of discharge $Cd=\frac{2\mathrm{A}(\sqrt{\mathrm{H1}}-\sqrt{\mathrm{H2}})}{\mathrm{T}a\sqrt{2\mathrm{g}}}$
	H1 (cm)	H2 cm					

Model Calculation : (For Reading No._____)

Area of orifice, a = πd2/4 = cm2

Plan area of Balancing (Orifice tank) tank, A =LxB= cm2

Coefficient of Discharge, $C_d=\frac{2A\,(\sqrt{H1}-\sqrt{H2})}{T.a.\sqrt{2g}}$ =

(g=981cm/Sec^2)

6. RESULT:_____

_____

7. INFERENCE:_____

_____

_____

_____

_____

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:

_____

_____

9. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awarded (50)
1. Handling of apparatus	A. Fully open the control valve to avoid bursting of pipes. B. Check condition of valves of tank. Check for working of stop watch	10	
2.Manipulation of apparatus	A. Measure dimensions of orifice tank B. measure the diameter of Orifice using Vernier caliper C. Switch on the Pump (If pump is not working go for Priming)	15	
3.Precise Operation/Activity	A. Fill the orifice tank to required head h_1 B. Record the time taken to descend the water level in the orifice tank from head $H_1$to head H_2. C. Calculate C_d of Orifice meter	20	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	5	
Total		50	

WORK SHEET

Name of the student:		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:

1. Title of the experiment: Coefficient of Contraction of Orifice by finding C_v and C_d

2. Objective of the experiment:

3. Apparatus/Tools required:

4. PROCEDURE:

1)
2)
3)
4)
5)
6)
7)

5. OBSERVATIONS :

Diameter of the Orifice (d) =.....cm

Size of the Collecting Tank L = ...cm; B =_____cm.

TABULAR FORM FOR C_V CALCULATION:

S. No	Head 'H' (cm)	Coordinates of Hook gauge scales (cm)						Coefficient of velocity $C_v = \sqrt{[X^2/(4YH)]}$
		Initial readings (cm)		Final readings (cm)		Actual (cm)		
		X_1	Y_1	X_2	Y_2	$X=(X_2-X_1)$	$Y=(Y_2-Y_1)$	
1								
2								
3								
4								
5								
Average C_v=								

SPECIMEN CALCULATION: (For Reading No:_____)

Co-efficient o velocity $C_v = \sqrt{[X^2/(4yH)]}$=

TABULAR FORM FOR C_d CALCULATION:

S. No.	Head 'H' (cm)	Time for 10cm(h) rise in collecting tank(T) in seconds	Actual discharge $Q_a=Ah/T$ (cm^3/sec)	Theoretical discharge $Q_{th}=a.\sqrt{(2gH)}$ (cm^3/sec)	Coefficient of discharge $Cd=Q_a/Q_{th}$	Coefficient of contraction $Cc=Cd/Cv$
1						
2						
3						
4						
5						
Average C_c =						

SPECIMENS CALCULATION: (For Reading No:_____)

Area of Orifice, a = (pi/4)*d^2 = ...cm^2

Internal plan area of Collecting Tank,A = L X B =.....cm^2

Actual Discharge, Q_a = Ah/T = ...cm^3/sec

Theoretical Discharge, Q_{th}= a$\sqrt{}$ (2gH)=.....cm^3/sec

Co efficient of discharge $C_d = Q_a / Q_{th}$

Co efficient of contraction $C_c = C_d/C_v$ =

6. RESULT:

_____

_____

_____

7. INFERENCE:

_____

_____

_____

_____

_____

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:

_____

_____

_____

9. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awarded (50)
1. Handling of instruments	A. Operation of valves B. Using Vernier callipers to know diameter of Orifice & Measuring the collecting tank dimensions C. Taking the reading of pointer gauge at different points	10	
2. Manipulation of apparatus	A. Reading a piezometer values without parallax. B. Maintaining constant head	15	
3. Precise Operation / Activity	A. Position of Vena-Contracta should be found accurately. B. Measuring the initial and final coordinates along jet trajectory.	20	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	5	
Total		50	

WORK SHEET

Name of the student:		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:

1. Title of the experiment: Coefficient of Discharge of Mouthpiece.

2. Objective of the experiment:

_____

_____

3. Apparatus/Tools required:

_____

_____

4. PROCEDURE:

1)
2)
3)
4)
5)
6)
7)
8)

WORK SHEET 3.3

5. OBSERVATIONS:

Diameter of mouth piece (d) : cm

Collecting tank plan dimensions : L=_____cm, B=_____cm

S. No.	Constant head(h)	Time for 10cm(H) rise in collecting tank(T)	$\sqrt{h}$	Actual discharge(Qa) =AH/T (cm3/sec)	Theoretical discharge Q_{th}=a.√2gh (cm^3/sec)	Coefficient of discharge (C_d)=Q_a/Q_{th}
1						
2						
3						
4						
5						
					Average C_d =	

SPECIMEN CALCULATION: (For Reading No:_____)

Plan Area of collecting Tank (A) = L x B = cm^2

Area of Mouthpiece, a = (pi/4)*d^2 = cm^2

Actual Discharge (Q_a) = (A H)/T = cm^3/sec

Theoretical discharge (Q_{th})=a.√2gh = cm^3/sec

Co efficient of discharge $C_d = Q_a / Q_{th}$ =

6.
RESULT:_____

_____

7.
INFERENCE:_____

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:

9. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awarded (50)
1. Handling of instruments	A. Use meter scale to measure dimensions of collecting tank and recording its dimensions. B. Use Vernier calipers to know diameter of mouthpiece	7	
2.Manipulation of apparatus	A. Operate outlet valve to know the rise of water in collecting tank. B. Operate inlet valve to maintain constant head C. Measure time required to constant rise in collecting tank after closing outlet valve	18	
3.Precise Operation/Activity	A. Convert all measurements into single unit B. Calculate C_d formouth piece. C. Plot the graph with specific parameters D. Compare graph with standard values	20	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	5	
Total		50	

WORK SHEET

Name of the student :		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:

1. Title of the experiment: Coefficient of Discharge Of Rectangular Notch

2. Objective of the experiment: _____

_____

3. Apparatus/Tools required: _____

_____

4. PROCEDURE:

5. OBSERVATIONS:

Plan Dimensions of Collecting Tank: L=_____cm, B=_____cm

Sill width of Rectangular Notch, b=_____cm

S. No.	Hook gauge readings in cm		Head over sill of notch in 'cm' H=h2-h1 (cm)	Time 'T' in 'sec' for h=10cm rise of water in collecting Tank (sec)	Actual discharge Ah/T (Q_a) (cm^3/sec)	Theoretical discharge (Q_{th}) (cm^3/sec)	Coefficient of discharge C_d= Q_a/Q_{th}
	Initial h1 (cm)	Final h2 (cm)					
1							
2							
3							
4							
5							
						Average value of C_d=	

Model Calculation: (For Reading No:_____)

Plan area of collecting Tank, A = LXB=_____cm^2

Actual Discharge, Q_a = Ah/T =_____cm^3/sec

Theoritical Discharge, Q_{th} = (2/3).b.$\sqrt{(2g)}$. $H^{3/2}$ =_____cm^3/sec
(g=981 cm/sec^2)

Co efficient of discharge $C_d = Q_a / Q_{th}$=

6. RESULT:

7. INFERENCE:

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:

9. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awarded (50)
1. Handling of apparatus	A. Measure size of Notch and collecting tanks. B. Fitting of hook gauge with shape edge needle to notch tank	**10**	
2.Manipulation of apparatus	A. Allow the water in to notch tank up to crest level of notch and record the point gauge reading. B. Control of Valves to regulate the flow C. The head over Notch measured from 4H from Notch	**15**	
3.Precise Operation/Activity	A. Regulate the flow of water to maintain constant depth over crest of notch by control valve B. Measure the depth of flow C. Note the time using the stop watch for 10cm rise of water in collecting tank	**20**	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	**5**	
	TOTAL	**50**	

WORKSHEET

Name of the student:		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:

1. Title of the experiment: Coefficient of Discharge Of Triangular Notch

2. Objective of the experiment:

_____

_____

3. Apparatus/Tools required:

_____

_____

4. PROCEDURE:

1)
2)
3)
4)
5)
6)
7)
8)

_____

5. OBSERVATIONS:

Plan Dimensions of Collecting Tank: L=_____cm, B=_____cm

Angle of V-Notch, θ =_____^{o}

S. No.	Hook gauge readings in 'cm'		Head over tip of notch in 'cm' $H=h_2-h_1$ (cm)	Time 'T' in sec for h=10cm rise of water in collecting tank (sec)	Actual discharge Q_a= Ah/T) (cm^3/sec)	Theoretic al discharge (Q_{th}) (cm^3/sec)	Coefficient of discharge C_d= (Q_a/Q_{th})
	Initial h_1 (cm)	Final h_2 (cm)					
1							
2							
3							
4							
5							
						Average C_d=	

Model Calculation: (For Reading No._____)

Plan area of collecting Tank, A = LXB=_____cm^2

Actual Discharge, Q_a = Ah/T =_____cm^3/sec

Theoritical Discharge, Q_{th} = (8/15).$\sqrt{(2g)}$.tan(θ/2) $H^{5/2}$ =_____cm^3/sec
(g=981 cm/sec^2)

Co efficient of discharge $C_d = Q_a / Q_{th}$=

6.
RESULT:_____

_____

7.
INFERENCE:_____

_____

_____

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:

_____

_____

_____

9. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awar ded (50)
1. Handling of apparatus	A. Measure size of Notch and collecting tanks. B. Fitting of hook gauge with shape edge needleto notch tank	**10**	
2.Manipulation of apparatus	A. Allow the water in to notch tank up to crest level of notch and record the point gauge reading. B. Control of Valves to regulate the flow C. The head over Notch measured	**15**	
3.Precise Operation/Activity	A. Regulate the flow of water to maintain constant depth over crest of notch by control valve B. Measure the depth of flow C. Note the time using the stop watch for 10cm rise of water in collecting tank	**20**	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	**5**	
	TOTAL	**50**	

WORK SHEET 3.1.6B **TRAPEZOIDAL NOTCH**

WORKSHEET

Name of the student:		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:

1. Title of the experiment: COEFFICIENT OF DISCHARGE OF TRAPEZOIDAL NOTCH

2. Objective of the experiment:

_____

_____

3. Apparatus/Tools required:

_____

_____

4. PROCEDURE:

1)
2)
3)
4)
5)
6)
7)
8)

_____

5. OBSERVATIONS:

Plan Dimensions of Collecting Tank: L=_____cm, B=_____cm

Sill width of the Notch, b =_____cm

Semi angle/ side slope with vertical, (θ/2) =_____^{o}

S. No.	Hook gauge readings in 'cm'		Head over sill of notch in 'cm' $H=h_2-h_1$ (cm)	Time 'T' in 'sec' for h=10cm rise of water in collecting tank T (sec)	Actual discharge $Q_a=Ah/T$ (cm^3/sec)	Theoretic al discharge Q_{th} (cm^3/sec)	Coefficient of discharge $C_d=Q_a/Q_{th}$
	Initial h_1 (cm)	Final h_2 (cm)					
1							
2							
3							
4							
5							
						Average C_d=	

Model Calculation: (For Reading No._____)

Plan area of collecting Tank, A = LXB=_____cm^2

Actual Discharge, Q_a = Ah/T =_____cm^3/sec

Theoritical Discharge, Q_{th} =$[(2/3).b.\sqrt{(2g)}.H^{3/2}] + [(8/15).\sqrt{(2g)}.\tan(\theta/2)\,H^{5/2}]$
(g=981 cm/sec^2)

=_____cm^3/sec

Co efficient of discharge $C_d = Q_a / Q_{th}$ =

6.
RESULT:_____

_____

7.
INFERENCE:_____

_____

_____

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:

_____

_____

9. COEFFICIENT OF DISCHARGE OF TRAPEZOIDAL NOTCH = _____

5. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awarded (50)
1. Handling of apparatus	A. Measure size of Notch and collecting tanks. B. Fitting of hook gauge with sharp edge needleto notch tank	**10**	
2.Manipulation of apparatus	A. Allow the water in to notch channelup to crest level of notch and record the point gauge reading. B. Control of Valves to regulate the flow C. The head over Notch measured	**15**	
3.Precise Operation/Activity	A. Regulate the flow of water to maintain constant depth over crest of notch by control valve B. Measure the depth of flow C. Note the time using the stop watch for 10cm rise of water in collecting tank	**20**	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	**5**	
	TOTAL	**50**	

WORK SHEET

Name of the student:		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:

1. Title of the experiment: verification of Bernoulli's Theorem

2. Objective of the experiment: _____

_____

3. Apparatus/Tools required: _____

_____

4. PROCEDURE:

1)
2)
3)
4)
5)
6)
7)
8)

5. OBSERVATIONS:

Plan Dimensions of Collecting Tank: L=_____cm, B=_____cm

S. no.	Diameter at cross section of pipe (d) cm	Time for H=10cm rise of water in collecting tank 'T' (sec)	Area of flow at the section $'a'(cm^2)$	Discharge $Q=(\mathrm{AH/T})$ $(\mathrm{cm^3/sec})$	Pressure head (p/w) (cm)	Velocity of flow $v=Q/a$ (cm/sec)	Velocity head $=v^2/2g$ (cm)	Total head $=H=$ p/w+ $v^2/2g$ (cm)
1								
2								
3								
4								
5								
6								
7								
8								

Model Calculation: (For Reading No._____)

Plan area of collecting Tank, A = LXB=_____cm^2

Area of flow at the section, a = $\pi d^2/4$ =_____cm^2

Actual Discharge, Q = Q_a = Ah/T=_____cm^3/sec

Velocity of flow, $v = Q/a$ =_____m/sec

Velocity Head $(v^2/2g)$ =_____cm (g=981 cm/sec^2)

Total Head (or) Energy= Pressure head (p/w) + Velocity head $(v^2/2g)$ =_____cm

6. RESULT:

7. INFERENCE:

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:

9. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awarded (50)
1. Handling of apparatus	A. Performance of Priming operation B. Controlling of flow rate by operating valves	6	
2.Manipulation of apparatus	A. Maintaining constant level by operating valves B. Measurement of piezometer reading at given sections without parallax C. Note down the time taken for 10 cm rise in collecting tank without parallax	19	
3.Precise Operation/Activity	D. Calculation of areas and actual discharge E. Calculation of velocity and velocity heads at various sections of piezometers. F. Calculation and verification of total heads at various sections.	20	
4. Values	G. Co-operation H. Co-ordination I. Communication J. Sharing K. Leadership	5	
Total		50	

WORK SHEET

Name of the student:		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:6

1. Title of the experiment: Coefficient of Discharge of Venturimeter

2. Objective of the experiment:

_____

_____

3. Apparatus/Tools required:

_____

_____

1)
2)
3)
4)
5)
6)
7)
8)
9)
10)
11)
12)

5. OBSERVATIONS:

Plan Dimensions of Collecting Tank: L=_____cm, B=_____cm

Diameter of inlet, d_1=_____cm

Diameter of throat, d_2 =_____cm

S. No.	Manometric readings (cm)			pressurehead ($\overline{h}$) $= x\,.\,(s_m/s_1-1)$ $= 12.6\,.x$ $s_{m=13.6}$ (for Mercury) $s_{1=1.0}$ (for water) (cm)	Time for H=10cm rise of water in collecting tank T (Sec)	Discharge (cm^3/sec)		Co-efficient of discharge, $C_d = Q_a / Q_{th}$
	h_1 (cm)	h_2 (cm)	Difference $x=(h_2 - h_1)$ (cm)			Actual $Q_a=AH/T$ (cm^3/sec)	Theoretical (Q_{th}) (cm^3/sec)	
1								
2								
3								
4								
5								
							Average C_d=	

Specimen Calculation: (For Reading No._____)

Plan area of collecting Tank, A = LXB=_____cm^2

Area of flow at inlet, $a_1=(\pi/4).d_1^2$ =_____cm^2

Area of flow at throat, $a_2=(\pi/4).d_2^2$ =_____cm^2

Actual Discharge, $Q_a = (AH/T)$ =_____cm^3/sec

Theoritical Discharge, $Q_{th} = [a_1\, a_1\sqrt{(2gh)}] / [\sqrt{(a_1^2 - a_2^2)}]$=_____

=_____cm^3/sec

Coefficient of Discharge, $C_d = (Q_a / Q_{th})$=_____.

6.

RESULT:_____

_____

7.
INFERENCE:_____

_____

_____

_____

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:
_____

_____

_____

9. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awarded (50)
1. Handling of apparatus	A. Fully open the control valve for varying flow rate. B. Check condition of valves for manometer, collecting tank, venturimeter conduit or pipe. C. Check for working of stop watch and Pump (If pump is not working go for Priming)	10	
2.Manipulation of apparatus	A. Release air bubbles in U tube manometer by using respective valves. B. Release valves of collecting tank	15	
3.Precise Operation/ Activity	A. Adjust control valve for required flow rate B. Record readings of u tube manometer. C. Record the time required to fill the collecting tank of required height. D. Calculate C_d of venturimeter	20	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	5	
Total		50	

WORK SHEET

Name of the student:		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:

1. Title of the experiment: Coefficient Of friction of pipe.

2. Objective of the experiment: _____

_____

3. Apparatus/Tools required:

_____

_____

4. Procedure:

1)
2)
3)
4)
5)
6)
7)
8)
9)
10)

5. Observations:

Plan Dimensions of Collecting Tank: L=_____cm, B=_____cm

Diameter of given pipe, d =_____cm

Length of the pipe between observation points, l =_____cm

S.No	Manometer reading'			Loss of head 'hf' of liquid	Time for H=10 cm rise of water in collecting tank 'T' (Sec)	Actual Discharge Q= AH/t (cm^3/sec)	Velocity V=Q/a (m/sec)	Frictionfactor (f) $=(h_f 2gd)/(4lv^2)$
	h_1 (cm)	h_2 (cm)	x $=h_1-h_2$ (cm)	$h_f = x\,.\,(s_m/s_1-1)$ $= 12.6\,.x$ S_m=13.6 (for Mercury) S_1=1.0 (for water) (cm)				
1								
2								
3								
4								
5								

Specimen Calculation: (For Reading No._____)

Plan area of collecting Tank, A = LXB=_____cm^2

Area of the pipe, a = (/4).d^2 =_____cm^2

Actual Discharge, Q_a =Q= (AH/T) =_____cm^3/sec

Velocity of flow, v = Q/a =_____cm/sec

Loss of Head due to friction of given pipe, $h_f = x\,.\,(s_m/s_1-1)$ =_____cm

[Specic gravity of manometric liquid Mercury, s_m = 13.6]
[Specic gravity of flowing liquid water, s_m = 1.0]
[Loss of Head due to friction, $h_f = (4.f.l.v^2)/(2gd)$]

Coefficient of friction, f =(hf.2g.d)/(4.l.v^2)=_____

= _____

6. RESULT:_____

_____

7. INFERENCE: _____

_____

_____

_____

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:

_____

_____

9. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awarded (50)
1. Handling of apparatus	A. Using of Vernier calipers to determine Dia of pipe. B. Identify the points in the pipe to know the Pressure difference	10	
2.Manipulation of apparatus	A. Regulate the valve to maintain the constant head B. Operate Control of valves for creating pressure difference between two points. C. Operate Control of valves for reservoir and collecting tank.	15	
3.Precise Operation/Activity	A. Note differential manometer reading. B. Measure 10 cm rise of water in collecting tank. C. Note the time taken for 10 cm rise by stop watch in seconds.	20	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	5	
Total		50	

WORK SHEET

Name of the student:		Date of experiment:
PIN:	Branch:	
Institution:		Experiment No:

1. Title of the experiment: Determination of Chezy's Constant

2. Objective of the experiment: _____

_____

3. Apparatus/Tools required: _____

_____

4. PROCEDURE:

1)
2)
3)
4)
5)
6)
7)
8)

5. OBSERVATIONS:

Plan Dimensions of Collecting Tank: L=_____cm, B=_____cm

Bed width of the open channel, b =_____cm

S. No.	Channel bed slope (i) eg, 1:20 means 1/20 = 0.05	Time takenfor H=10cm rise of water in collecting tank 'T' (sec)	Flow Rate $Q=Q_a=(AH/T)$ (cm^3/sec)	Depth of flow (h)				Areaof flow $A_f= bh$ (cm^2)	Wetted perimeter P =b+2h (cm)	Hydraulic Mean radius m=A/P (cm)	Velocity of flow v= Qa/Af (m/sec)	Chezy's constant C = V/√(m.i)
				Y_1 (cm)	Y_2 (cm)	Y_3 (cm)	$h=Y_{avg}$ (cm)					
1												
2												
3												
4												
5												
Average Value of Chezy's constant C =												

Model Calculation: (For Reading No._____)

Plan area of collecting Tank, A = LXB=_____cm^2

Actual Discharge, Q_a =Q= (AH/T) =_____cm^3/sec

Area of the flow, $A_f = b \cdot h$ =_____cm^2

Wetted perimeter, P = b + 2h =_____cm

Hydraulic Mean Radius, m = (A_f/P) =_____cm

Velocity of flow, v = (Q/A_f) =_____m/sec

Channel bed slope, 'i'=1:n = (1/n)=_____

Chezy's constant, $C = V/\sqrt{(m.i)}$=_____

6. RESULT:

7. INFERENCE:

8. DEFICIENCIES/MALFUNCTIONING OF ANY APPARATUS:

9. SCHEME OF EVALUATION

Category of skill	Sub Task	Weight with competency level individually	Awarded (50)
1. Handling of apparatus	A. Setting the slope of the channel. B. Operating valves to maintain steady flow.	10	
2.Manipulation of apparatus	A. Reading the slope of the channel B. Touching the tip of the guage with top surface of the water level. C. In collecting tank, Noting the time taken for 10cm rise in the piezometer.	15	
3.Precise Operation/Activity	A. Reading the guage after touching the water level in the flow. B. Calculating hydraulic mean radius, velocity for the discharge C. Calculating the values of chezy's constant for different discharges	20	
4. Values	A. Co-operation B. Co-ordination C. Communication D. Sharing E. Leadership	5	
Total		50	

4. EXPERIMENTAL METHODOLOGIES

DETERMINATION OF COEFFICIENT OF DISCHARGE OF AN ORIFICE BY CONSTANT HEAD METHOD

A. THEORY

An orifice is an opening in the side or bottom of a tank,through which the liquid will flow under the condition that the liquid surface is always above the top edge of the opening.The orificeisused for the measurement of flow of liquids.

B. PROCEDURE

1. **Measure** the **diameter**of the**orifice.**
2. **Measure** the **internalplan dimensions** of the **collecting tank**.
3. **Switch on** the **motor**.
4. **Open** the **inletvalve** to allow the **water** into **balancing tank.**
5. **Maintain** the **Constanthead** in the **balancing tank**by **operating** the **inlet valve.**
6. **Close** the **outlet valve** of the **collecting tank.**
7. **Measure** the **time** taken for **knownrise(H) of water** level in the **collecting tank**.
8. **Calculate** the $C_d$forevery observation and **find** the **average** of all observations.

B. OBSERVATIONS AND TABULATIONS

a) Diameter of the orifice d = 1.5cm.

b) Plan dimensions of the collecting tank = 30 X 30 cm.

S. No	Constant head h (cm)	Time for H=10 cm Rise of water level in the collecting tank T (sec)	Actual Discharge $Qa = \frac{AH}{T}$ cm^3/sec	Theoretical Discharge $Qth = a\sqrt{2gh}$ cm^3/sec	Coefficient of discharge $Cd = \frac{Qa}{Qth}$
1	30	33.73	266.82	428.69	0.62
2	35	30.36	296.44	463.04	0.64
3	38	29.95	300.5	482.47	0.62
4	41	28.48	316.01	501.16	0.63
5	44	27.42	328.22	519.17	0.63
6	47	26.91	334.44	536.58	0.62
Total					3.76

Average value of Cd =0.62

C.SPECIMEN CALCULATIONS (reading no 1)

Cross sectional Area of the orifice a= $\frac{\pi}{4} \times 1.5^2$ = 1.767cm^2

Plan area of the collecting tank = $A = 30\ X\ 30$ = 900cm^2

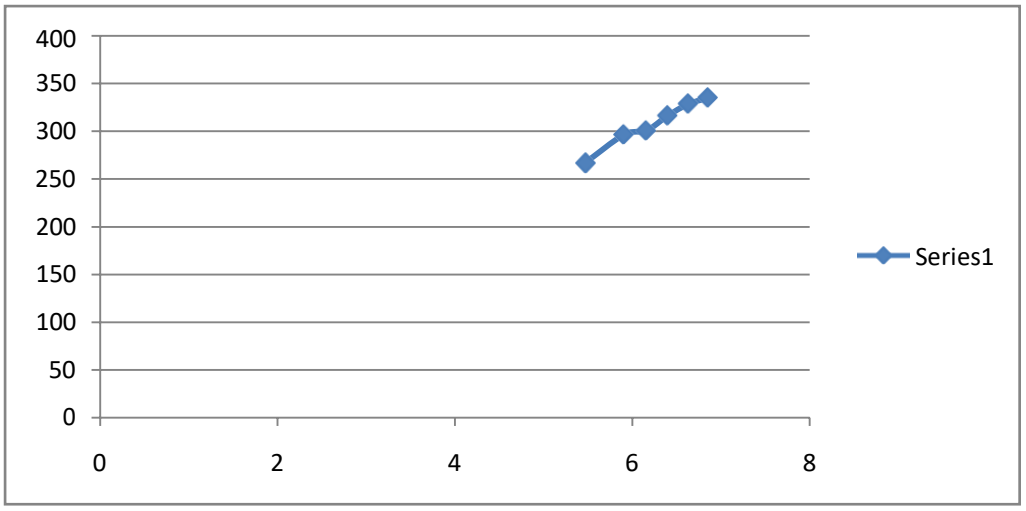
Actual Discharge = $Qa = \frac{30X30\ X\ 10}{33.73}$ = 266.82 cm^3/sec

Theoretical Discharge = $Qth = 1.767X\sqrt{2X981X30}$ = 428.69 cm^3/sec

Coefficient Discharge $Cd = \frac{Qact}{Qth} = \frac{266.82}{428.69}$ = 0.62

D.GRAPH

Draw the graph such that independent variable is on horizontal-axis ($\sqrt{h}$) and dependent variable (Qa) on vertical axis.



Slope of the graph is = (Qa/$\sqrt{h}$) = 48.81

C_d = Slope from the graph / (.$\sqrt{2g}$)

$= 48.81 / (1.767 \times \sqrt{(2 \times 981)}) = 0.62$

D.RESULT

Average $Cd = \frac{3.76}{6}$ = 0.62

Cd from the graph = 0.62

E.INFERENCE

DETERMINATION OF COEFFICIENT OF DISCHARGE OF AN ORIFICE BY VARIABLE HEAD METHOD

A. THEORY

The time taken for the liquid to descend from one level to another, when the liquid is discharged through an orifice with no inflow. The coefficient of discharge is calculated using the expression,

$$Cd=\frac{2(\sqrt{H1}-\sqrt{H2})}{Ta\sqrt{2g}}$$

Where T = Time required for the liquid to descend from head H_1 to H_2

A = Internal plan area of the orifice tank/balancing tank

a = Area of the orifice

g = Acceleration due to gravity =

H_1 = Initial head in the orifice tank

H_2 = Final head in the orifice tank

C_d = Coefficient of discharge

B. PROCEDURE

1. Measure the internal dimensions of the orificetank.
2. Measure the diameter of the orifice.
3. By regulating the supply valve,water is allowed into theorificetank so that the headabove the centre of the orifice is H_1.
4. The supply valve is completely closed and the water level in the orifice tank isallowed to descend.
5. Note down the time 'T' taken to fall head from H_1 to H_2.
6. The above procedure is repeated for different values of H_1 and H_2 and time taken in each case is observed.
7. The observations are tabulated and co-efficient of dischargeis calculated.

C. OBSERVATIONS AND TABULATIONS

Diameter of Orifice d = 15 mm
Internal plan dimensions of the tank, Length = 300mm
Breadth= 300 mm

S. No	Head over the Orifice		Time taken to fall head from H_1 to H_2 T sec	$\sqrt{H1}$	$\sqrt{H2}$	$\sqrt{H1}-\sqrt{H2}$	Coefficient of discharge $Cd=\frac{2A(\sqrt{H1}-\sqrt{H2})}{Ta\sqrt{2g}}$
	Initial H_1 mm	Final H_2 mm					
1	780	680	20	27.93	26.08	1.85	0.67
2	640	540	22.06	25.30	23.24	2.06	0.68
3	500	400	25.66	22.36	20.00	2.36	0.67
4	380	280	32.69	19.49	16.73	2.76	0.61
5	250	150	42.5	15.81	12.25	3.56	0.61
	Avarage C_d						0.65

D. SPECIMEN CALCULATIONS

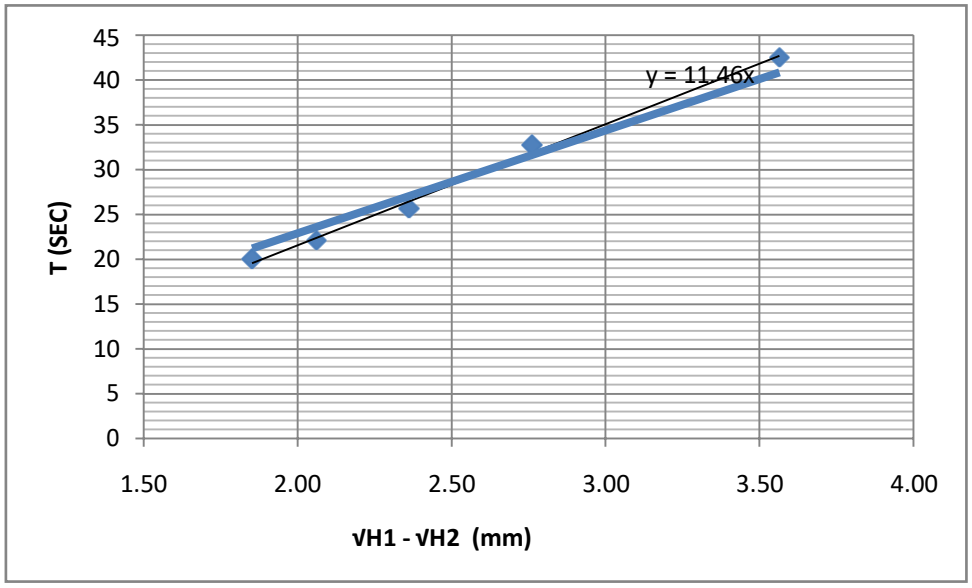
Area of Orifice $a = \frac{\pi}{4}d^2 = 176.71\ mm^2$

Internal plan area of the balancing tank, A =90000mm^2

Coefficient of discharge, $Cd=\frac{2(\sqrt{H1}-\sqrt{H2})}{Ta\sqrt{2g}}$ = 0.67

E. GRAPHS

A graph $(\sqrt{H1} - \sqrt{H2})$ V_S T is drawn taking ($\sqrt{H1} - \sqrt{H2}$) on x - axis



Slope from graph = [T / $(\sqrt{H1} - \sqrt{H2})$] =

$C_d = \frac{2A\,(\sqrt{H1} - \sqrt{H2})}{T.a.\sqrt{2g}}$

$= \frac{2A}{a.\sqrt{2g}} \times \frac{(\sqrt{H1} - \sqrt{H2})}{T}$

$= \frac{2A}{a.\sqrt{2g}} \times \left(\frac{1}{Slope\ from\ Graph}\right)$

=

F. RESULT

Coefficient of dischargetheoretical, C_d = 0.65
Coefficient of discharge from graph, C_d = 0.63

G. INFERENCE

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Determination of Co-efficient of Contraction 'Cc' of an orifice by finding Cv & Cd.

A. THEORY

An Orifice is an opening in the side or bottom of a tank or a reservoir through which fluid is allowed to flow in the form of a jet. The discharge of flow depend up on the head of the fluid (H) above the center of the orifice. The term small orifice means that the diameter of the orifice is relatively small compared with the head producing flow.

Coefficient of velocity is found by considering the trajectory of a jet formed by the discharge of water through an orifice mounted in the side of a tank. The jet is subjected to a downward acceleration of 'g' due to gravity. The distance travelled by the jet in both horizontal and vertical axes taking the origin of co-ordinates at the vena-contracta and at any other point along trajectory of the jet and applying the laws of motion in the horizontal and vertical axes, we can calculate the coefficient of velocity. During this process the effect of air resistance if any on the jet is ignored.

Measurement of coefficient of discharge by Constant head method:

Theoretical discharge, $Q_{th} = a \sqrt{(2gh)}$

Where a = area of orifice in cm^2

h= head of water above the mouth piece in cm

Actual discharge, $Q_a = (A * H) / T$

Where A =Area of the collecting tank in cm^2

T=Time taken for water level to rise by H cm in collecting tank in seconds.

Coefficient of discharge is defined as the ratio of actual discharge to theoretical discharge

$C_d = Q_a / Q_{th}$

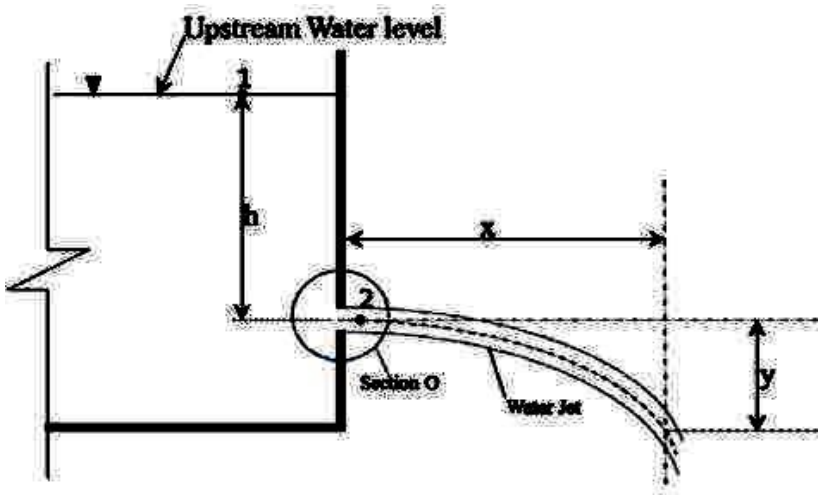
Calculate Cv from the equation

$Cv = \sqrt{(x^2/4yh)}$

B. PROCEDURE

1. **Measure** the **diameter** of the **Orifice**.
2. **Measure** the internal **size of** the **collecting tank**.
3. Do **priming** of motor if required and **switch on the motor**.
4. **Maintain** the **water level constantly at** certain height by **adjusting** the main valve of motor or other **valves** provided for the same purpose.
5. **Note down** the **head value** by means of the scale provided at the side of the tank.
6. **Close** the **collecting tank out let valve** and **note down** the **time** taken for **10 cm rise** in water level in the collecting tank. (After noting down the time, quickly release the collecting tank valve to avoid overflow)

7. **Note down** the initial values of X i.e**X_1 and Y_1** by coinciding the tip of the sliding hook gauge fixed with measuring scale near to top of the jet at the vena contracta.
8. Now **slide the hook gauge** in horizontal direction **away from the orifice, along the jet** direction and **randomly** take another set of values in X and Y scales after coinciding the tip of the scale to the top of the jet projectile. **Note down** those values as **X_2 and Y_2**.
9. **Repeat** the **steps 4 to 8** to get at least **6 readings** by **varying the head values** by adjusting main valve or other valves provided for the same purpose.
10. Readings of**6 different heads** are noted in a tabular form given below.



C. OBSERVATIONS AND TABULATIONS

For Cv calculation:

S.No	Head 'h' (cm)	Jet Coordinates						Coefficient of Velocity (C_v) =Sqrt(x^2/[4yh])
		Measured values in cm				Net values in cm		
		X_1	X_2	Y_1	Y_2	$X=(X_2-X_1)$	$Y=(Y_2-Y_1)$	
1	28	13	25.7	12	8.5	12.7	3.5	0.641
2	48	13	38	12.3	4.5	25	7.8	0.646
3	55.5	13	24	9.9	8.6	11	1.3	0.648
4	57	12.7	33.2	12.4	7.8	20.5	4.6	0.633
5	66.5	13	41	12.4	6.25	28	6.15	0.692
6	73	13	41	12.4	6.65	28	5.75	0.683

For Cd calculation:

S. No.	Constant head (h) in cm	Time for H=10cm rise of water level in collecting tank 'T' (sec)	Actual discharge Q_a=AH/T	Theoretical discharge Q_{th} = a.√(2gh)	Coefficient of discharge Cd=Q_a/Q_{th}	Coefficient of Contraction $C_c = C_d / C_v$
1	28	34.75	258.99	414.36	0.625	0.974
2	48	27.5	327.27	542.52	0.603	0.934
3	55.5	24.41	368.70	583.37	0.632	0.976
4	57	24.15	372.67	591.20	0.630	0.996
5	66.5	22.54	399.29	638.57	0.625	0.903
6	73	21	428.57	669.05	0.641	0.937

D. SPECIMEN CALCULATIONS

Actual discharge, $Q_{act} = \frac{Ah}{T} = \frac{900 \times 10}{34.75} = 258.99\ cm^3/s$

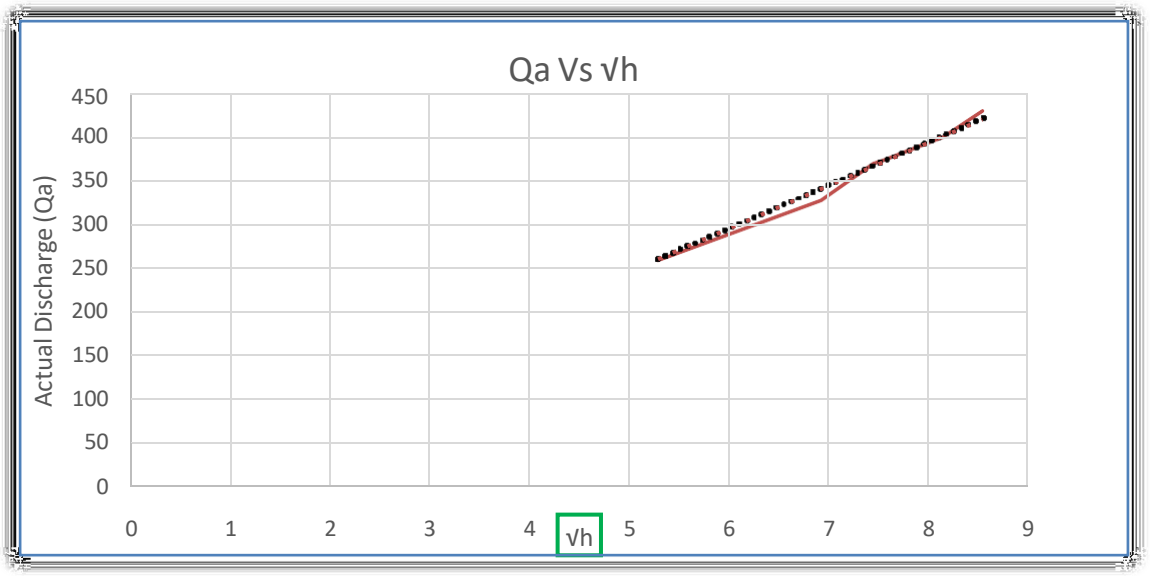
Theoretical discharge, $Q_{th} = a\sqrt{2gh} = \frac{\Pi}{4} x\ d^2 \times \sqrt{(2*981*28)} = 414.358\ cm^3/s$

Co-efficient of discharge, $C_d = \frac{Q_a}{Q_{th}} = \frac{258.99}{414.358} = 0.625$

Calculation of velocity, $Cv = \sqrt{(x^2/4yH)} = \sqrt{*(12.7)^2/(4*3.5*28)}] = 0.641$

Coefficient of Contraction Cc = Cd/Cv = 0.625 / 0.641 = 0.974

E. GRAPHS : 1) Q_a Vs √h



F.RESULT

From graph,

slope of the line = $(Q_a/\sqrt{h})$=

C_d = slope of the line / (a $\sqrt{2g}$)=

Average hydraulic Co-efficient

of velocity of an Orifice, C_v = 0.657

of discharge of an Orifice, C_d = 0.626

of contraction of an Orifice, Cc = 0.953

G.INFERENCE

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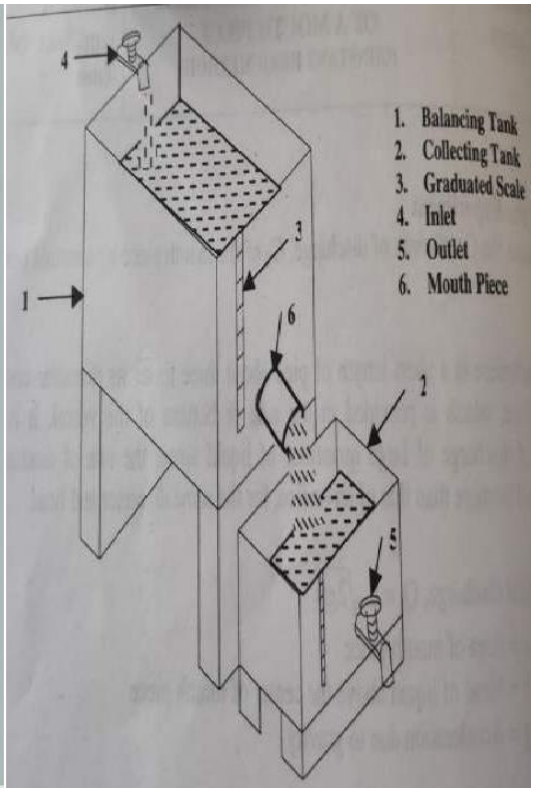
DETERMINATION OF COEFFICIENT OF DISCHARGE OF A MOUTHPIECE BY CONSTANT HEAD METHOD

A. THEORY

Mouth piece is a short length of pipe about three times its diameter, connected to the face of an orifice, which is provided in the side or bottom of the vessel. It is used for the measurement of discharge of liquid. The rate of discharge through a mouth piece is more than that of an orifice for the same diameter and head, it gives more discharge than orifice.

B. PROCEDURE

1. **Measure** the **internal diameter** of the **mouth piece.**
2. **Measure** the **internalplan dimensions** of the **collecting tank**.
3. **Switch on** the **motor**.
4. **Open** the **inletvalve** to allow the **water** into **balancing tank.**
5. **Maintain** the **constant head** in the **balancing tank** by **adjusting** the **inlet valve.**
6. **Close** the **outlet valve** of the **collecting tank.**
7. **Measure** the **time** taken for **knownrise(H) of water** level in the **collecting tank**.
8. **Calculate** the **Cd**forevery observation and **find** the **average** of all observations.



B. OBSERVATIONS AND TABULATIONS

a) Diameter of the mouth piece d= 20 mm

b) Plan dimensions of the collecting tank = 300 X 300 mm

S. No	Constant head h (mm)	Time for H=100mm rise of water level in the collecting tank T (sec)	Actual Discharge $Q_a = \frac{AH}{T}$ mm³/sec	Theoretical Discharge $Q_{th} = a\sqrt{2gh}$ mm³/sec	Coefficient of discharge $Cd = \frac{Q_a}{Q_{th}}$
1	210	21.38	420954.16	637690.63	0.66
2	260	19.22	468262.23	709556.63	0.66
3	310	17.60	511363.64	774785.06	0.66
4	360	16.33	551132.88	834933.03	0.66
5	410	15.30	588235.29	891029.98	0.66
6	460	14.45	622837.37	943789.55	0.66
Total					3.96

C.SPECIMEN CALCULATIONS

Cross sectional Area of the mouth piece a= $\frac{\pi}{4}20^2$ = 314.16 mm²

Plan area of the collecting tank = $A = 300\ X\ 300$ = 90000 mm²

Actual Discharge = $Qa = \frac{300X300\ X\ 100}{21.38}$ = 420954.16 mm³/sec

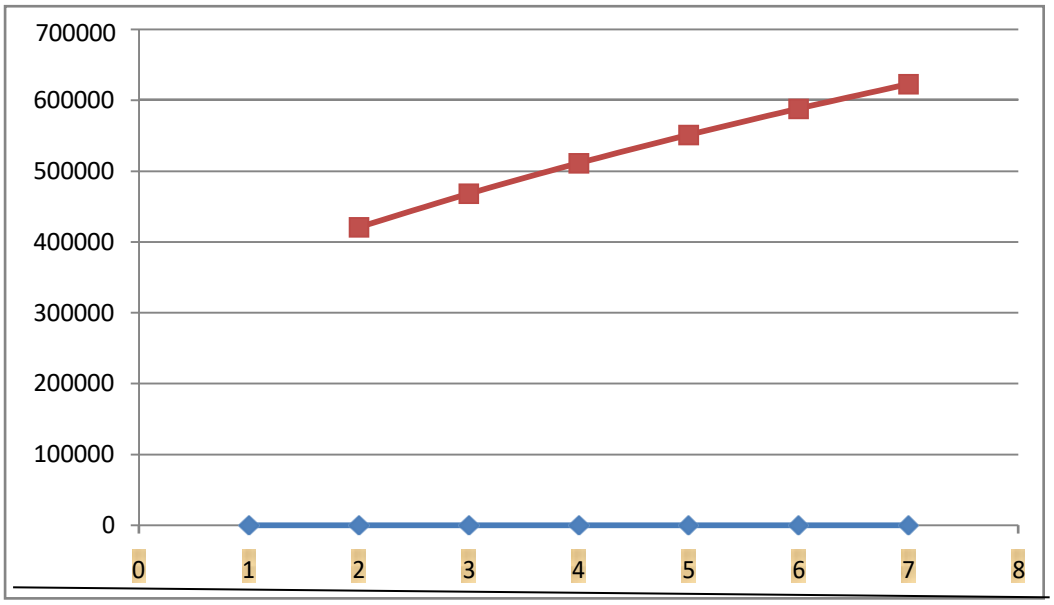
Theoretical Discharge = $Qt = 314.16X\sqrt{2X9810X210}$ = 637690.63 mm³/sec

Coefficient Discharge $Cd = \frac{Qa}{Qt} = \frac{420954.16}{637690.63}$ = 0.66

D.GRAPH

Draw the graph such that independent variable ($\sqrt{h}$) is on horizontal-axis and

dependent variable (Qa) on Vertical axis



From graph,

slope of the line = ($Q_a/\sqrt{h}$)= 29042.07

C_d = slope of the line / (a $\sqrt{2g}$)= 29042.07 / (314.16 x $\sqrt{2\ x\ 9810}$)

= 0.66

D.RESULT

Sum of the Cd from all the observations

Average C_d = ...

No. of observations

Average $C_d = \frac{3.96}{6}$ = 0.66

C_d from the graph = 0.66

E.INFERENCE

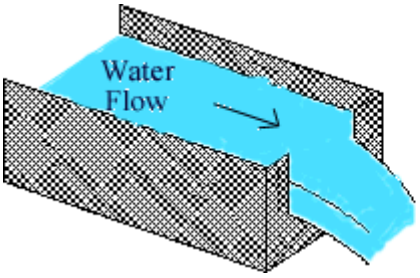
Generally Actual discharge is less when compared to theoretical discharge because of frictional losses, manufacturing defects and non idealistic conditions.

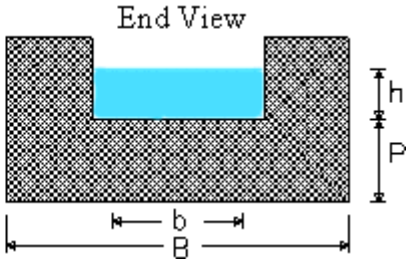
RECTANGULAR NOTCH

(1) COEFFICIENT OF DISCHARGE OF RECTANGULAR NOTCH

THEORY

Notches are used to determine the quantity of water flowing through a flume or channel. The flow is regulated over a notch, which could be rectangular, triangular or trapezoidal in shape. In this experiment a rectangular notch is used.





A.PROCEDURE

1. **Note** the **Dimensions** of the given **Notch** by using **Scale.**
2. **Open** the **control valve** and allow the water level to **riseup**to the **sill level of the notch**
3. Adjust the**tip of hook gauge such** that it coincides with water surface and **note** the reading on **gauge scale**as **(h1)**
4. **Operate** the **controlvalve(s)**such that the **water flows** over the **notch** to some height above the sill level.
5. **Note** the **water level** by means of **hook-gauge(h2)**
6. **Note** the time(T) required for **water level** in the **collecting tank** to **known height(H)**

A. OBSERVATIONS AND TABULATIONS

S. No	Hook gauge reading (mm)		Head over sill of notch(mm) h=h2-h1	Time (T) in 'sec' for 100mm (H) rise of water level in collecting tank	Actual discharge Qa = AH/T m^3/sec	Theoretical discharge(Qth) m^3/sec	Coefficient of discharge $Cd = Qa/Qth$
	Initial h1 (mm)	Final h2 (mm)					
1	0	22	22	27.00	6.64×10^{-4}	9.63×10^{-4}	0.69
2	0	38	38	12.20	14.57×10^{-4}	21.87×10^{-4}	0.67
3	0	57	57	8.31	21.66×10^{-4}	34.01×10^{-4}	0.64
4	0	59	59	6.82	21.39×10^{-4}	42.32×10^{-4}	0.62
5	0	63	63	6.03	29.85×10^{-4}	46.62×10^{-4}	0.64
Average Cd							0.65

C.SAMPLE CALCULATIONS

Head differenceh = h2-h1

= 22-0 = 22mm or 0.022m

Theoretical discharge(Q_{th}) = (2/3) b $\sqrt{2g}$ $(h)^{3/2}$ m^3/sec [g=9.81m/sec^2]

= $0.67x0.1x4.429x(0.022)^{3/2}$

= $9.63x10^{-4}m^3/sec$

Area of collecting tank(A) = 0.3x0.6m = $0.18m^2$

Rise in water level in collecting tank, h = 10cm = 0.10 m

Time taken T = 27.00 sec

Actual discharge (Qa) = 0.3X0.6X0.1/27.00 m^3/sec

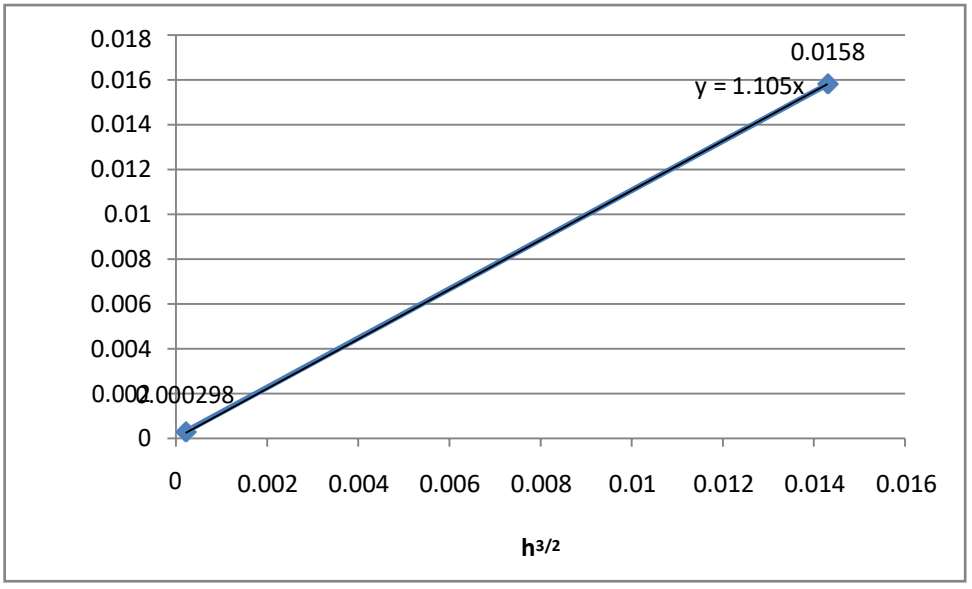
= $6.64x10^{-4}$ m^3/sec

Coefficient of dischargeCd =$6.64x10^{-4}m^3/sec/9.63x10^{-4}m^3/sec$

=0.69

GRAPH:

Draw the graph Qa (vs) $h^{3/2}$; Qa on vertical axis and $h^{3/2}$ on horizontal axis.



From Graph,

Slope of the straight line = (Qa / $h^{3/2}$)= 0.8916

Cd = (Slope of straight line) /[(2/3) b $\sqrt{2g}$] = _____

D.RESULT

Average Coefficient of discharge (C_d) for rectangular notch= **0.65**

Coefficient of discharge (C_d) from graph = _____

E.INFERENCE

TRIANGULAR NOTCH

(1) COEFFICIENT OF DISCHARGE OF TRIANGULAR NOTCH

THEORY

Notches are used to determine the quantity of water flowing through a flume or channel. The flow is regulated over a notch, which could be rectangular, triangular or trapezoidal in shape. In this experiment a v-notch is used.

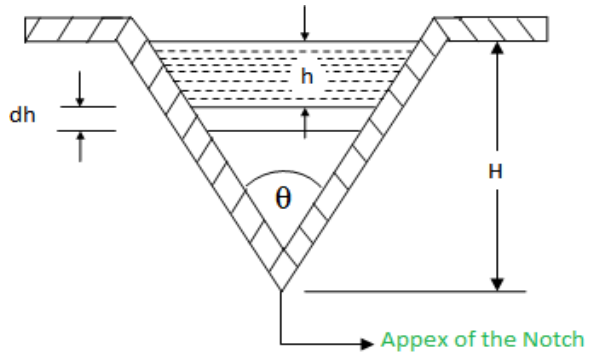


Fig : Triangular Notch

A. PROCEDURE

1. **Note** the **Dimensions** of the given **Notch** by using **Scale.**
2. **Open** the **control valve** and allow the water level to **rise up**to the **sill level of the notch**
3. Adjust the **tip of hook gauge** that it coincides with water surface and **note** the reading on **gauge scales** as **(h1)**
4. **Operate** the **control valves** such that the **water flows** over the **notch** to some height
5. **Note** the **water level** by means of **hook-gauge(h2)**
6. **Note** the time(t) required for **water level** in the **collecting tank** to **known height(h)**

B. OBSERVATIONS AND TABULATIONS

S. No	Hook gauge reading (mm)		Head over sill of notch(mm) h=h2-h1 (mm)	Time (T) in 'sec' for H=100mm rise of water level in collecting tank	Actual discharge $Q_a = AH/T$ (m^3/sec)	Theoretical discharge(Qth) (m^3/sec)	Coefficient of discharge $Cd = Q_a/Q_{th}$
	Initial h1 (mm)	Final h2 (mm)					
1	6	36	30	113.6	1.58×10^{-4}	2.12×10^{-4}	0.74
2	6	54	48	38.19	4.71×10^{-4}	6.85×10^{-4}	0.68
3	6	69	63	20.59	8.74×10^{-4}	13.58×10^{-4}	0.64
4	6	78	72	15.12	11.96×10^{-4}	18.97×10^{-4}	0.62
5	6	94	88	9.10	19.78×10^{-4}	31.33×10^{-4}	0.63
						Average value of Cd=	0.66

C. SAMPLE CALCULATIONS

Head difference h = h2-h1= 36 - 6 = 30mm = 0.03m
Angle of Notch, $\theta = 60^0$
Area of collecting tank (A) = 0.3 x 0.6 =0.18m^2
Rise of water level in the collecting tank H = 100 mm = 0.1m
Time taken for above, T = 113.6 sec
Actual discharge (Q_a) = A H / T = (0.18X0.1)/113.6
=1.58x$10^{-4}m^3$/sec
Theoretical discharge (Q_{th}) = 8/15$\sqrt{2g}$ tan(ɵ/2) $(h)^{5/2}$ (g=9.81m/sec^2)
= 0.533x4.429x0.577x$(0.03)^{5/2}$
= 2.12x$10^{-4}m^3$/sec
Coefficient of discharge (C_d) = 1.58x10^{-4}/2.12x10^{-4}
=0.74

D. RESULT

Average coefficient of discharge(Cd) for triangular notch= **0.66**

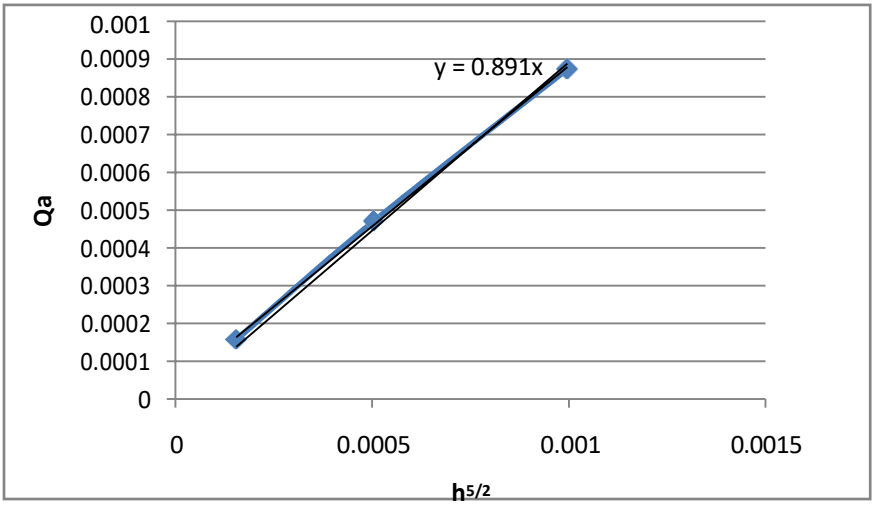
GRAPH

Draw the graph Q_a (vs) $h^{5/2}$; Q_a on vertical axis and $h^{5/2}$ on horizontal axis.

Slope of the trend line of the graph ($Q_a/h^{5/2}$) = 0.8916.

Coefficient of discharge C_d from graph = (slope of the line from graph)/8/15$\sqrt{2g}$ tan(ɵ/2)

= 0.8916/1.362 = 0.65



B. INFERENCE_____

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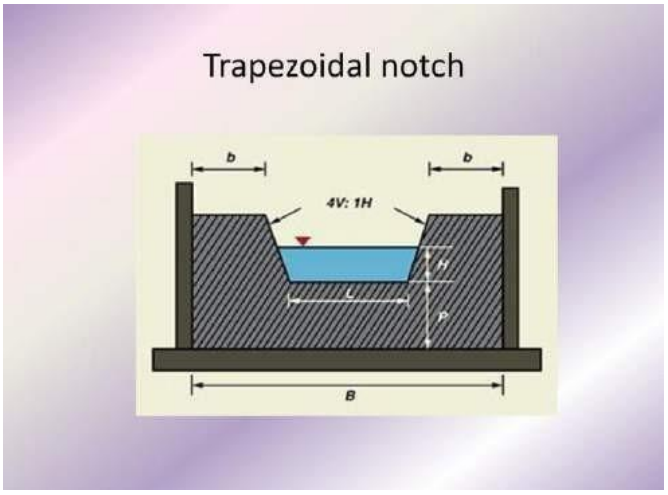
TRAPEZOIDAL NOTCH

(1) COEFFICIENT OF DISCHARGE OF TRAPEZOIDAL NOTCH TAPEZOIDAL NOTCH

THEORY

Notches are used to determine the quantity of water flowing through a flume or channel. The flow is regulated over a notch, which could be rectangular, triangular or trapezoidal in shape. In this experiment a trapezoidal notch is used.



A.PROCEDURE

1. **Note** the **Dimensions** of the given **Notch** by using **Scale.**
2. **Open** the **control valve** and allow the water level to **rise up**to the **sill level of the notch**
3. Adjust the**tip of hook gauge** that it coincides with water surface and **note** the reading on **gauge scales**as **(h1)**
4. **Operate** the **controlvalves** such that the **water flows** over the **notch** to some height
5. **Note** the **water level** by means of **hook-gauge(h2)**
6. **Note** the time(T) required for **water level** in the **collecting tank** to **known height(H)**

B. OBSERVATIONS AND TABULATIONS

S. No	Hook gauge reading (mm)		Head over sill of notch(mm) h=h2-h1	Time (T) in sec for H mm rise	Actual discharge AH/T(Qact) m^3/sec	Theoretical discharge(Qth) m^3/sec	Coefficient of discharge Cd
	Initial h1 (mm)	Final h2 (mm)					
1	65	32	22	44.53	5.61×10^{-4}	9.0×10^{-4}	0.69
2	65	35	38	52.97	4.71×10^{-4}	7.8×10^{-4}	0.67
3	65	38	57	62.25	4.01×10^{-4}	6.6×10^{-4}	0.64
4	65	41	59	69.38	3.60×10^{-4}	5.5×10^{-4}	0.62

5	65	44	63	88.82	$2.81x10^{-4}$	$4.5x10^{-4}$	0.64
Average Cd							0.65

C.SAMPLE CALCULATIONS

Head difference h =h2-h1

22-0=22mm or 0.022m

Theoretical discharge(Q_{th})m^3/sec = $8/15\sqrt{2g}\tan(\theta/2)(h)^{5/2}+2/3L\sqrt{2g}(h)^{3/2}$

Coefficient of discharge C_d = $5.61x10^{-4}$/ $9.0x10^{-4}$

=0.69

D.RESULT

Average Coefficient of discharge(Cd) for rectangular notch= **0.65**

GRAPH

Draw the graph Qa (vs) Qth; Qa on vertical axis and Qth on horizontal axis

Slope of straight line = Cd = Qa/Qth = _____

E. INFERENCE_____

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VERIFICATION OF BERNOULLI'S THEOREM

A. THEORY

The Bernoulli's theorem states that, in a steady incompressible flow of an ideal fluid, the Total energy per unit weight or Total head at any point remains constant. Gravity and pressure forces are alone considered in the continuous flow along the stream lines and frictional forces are neglected The Total head at any two sections will have the following relation in a frictionless flow.

$$\frac{p_1}{w} + \frac{v_1^2}{2g} + z_1 = \frac{p_2}{w} + \frac{v_2^2}{2g} + z_2$$

Where,

$\frac{p}{w} = pressure\ energy\ per\ unit\ weight\ (or\ head)$

$\frac{v^2}{2g} = kinetic\ energy\ per\ unit\ weight\ (or\ velocity\ head)$

$z = potential\ energy\ per\ unit\ weight\ (or\ datum\ head)$

$Q = discharge = \frac{A.H}{T}$ and

$A = \text{Plan } Area\ of\ collecting\ tank$

$H = rise\ of\ water\ (cm)$

$T = time\ taken\ for\ 'H'\ cm\ rise\ in\ collecting\ tank$

B.PROCEDURE

1. Take **center line** of the conduit as **Datum line**.
2. **Open the inlet valve** to allow the flow from the supply tank through the conduit.
3. Adjust the **outlet valve** of the apparatus so that a **constant head is maintained** in the supply tank of the apparatus.
4. **Measure the pressure heads** in the piezometers placed at various sections above the centre line of the conduit. Ensure that no air bubbles are present in piezometers.
5. **Note the time taken** $'T'\ (\mathbf{sec})$ for a rise of known height $'H'\ (cm)$ in the collecting tank.

6. **Calculate area of cross section of the conduit** at each section where pressure heads are taken(available in manual supplied by manufacturer).
7. **Calculate the velocity of flow** at respective sections and hence velocity head at each section.
8. **Change the flow rate** and repeat the procedure for **2 or 3 times.**
9. Tabulate the observations and calculate the Total heads.

C. OBSERVATIONS AND TABULATIONS

S. no.	Diameter ofcross section of conduit In mm	Time for H=10cm rise of water level in collecting tank 'T' (sec)	Area of flow at the section $'a'(m^2)$	Discharge $(Q = \frac{A.H}{T})\ (m^3/sec)$	Pressure head $(\frac{p}{w})$ in (m)	Velocity of flow $v = Q/a(m/sec)$	Velocity head $(\frac{v^2}{2g})$in (m)	Total head $(H = \frac{p}{w} + \frac{v^2}{2g})$ in (m)
I.	42.95	35 sec	0.001448	$2.57x10^{-4}$	0.182	0.177	0.0016	0.183
	39.25		0.001209		0.181	0.212	0.0023	0.183
	35.55		0.000992		0.180	0.259	0.0034	0.183
	31.85		0.0007963		0.177	0.322	0.0053	0.182
	28.15		0.000622		0.176	0.413	0.0087	0.184
	24.45		0.0004692		0.165	0.547	0.0152	0.180
	20.75		0.0003379		0.149	0.760	0.0294	0.179
	17.05		0.00022852		0.085	1.124	0.0644	0.149

D. SPECIMEN CALCULATIONS (For Reading No._____)

Plan Area of collecting tank, $A = 0.3 \text{ x } 0.3 = 0.09\ m^2$

Areas of flow section at the section, $a = 0.001448 m^2$

Time taken for a rise of water, $= 35$ sec

Actual discharge,

$$Q = \frac{A.H}{T} = 0.000257\ m^3/sec$$

Pressure head at the section, (-) $0.182\ (m)$

w

E. RESULT

For a discharge 'Q', the $Total\ head =$_____(m)

Velocity of flow at a section $v_1\ (= \frac{}{a_1} = 0.177(m/sec)$

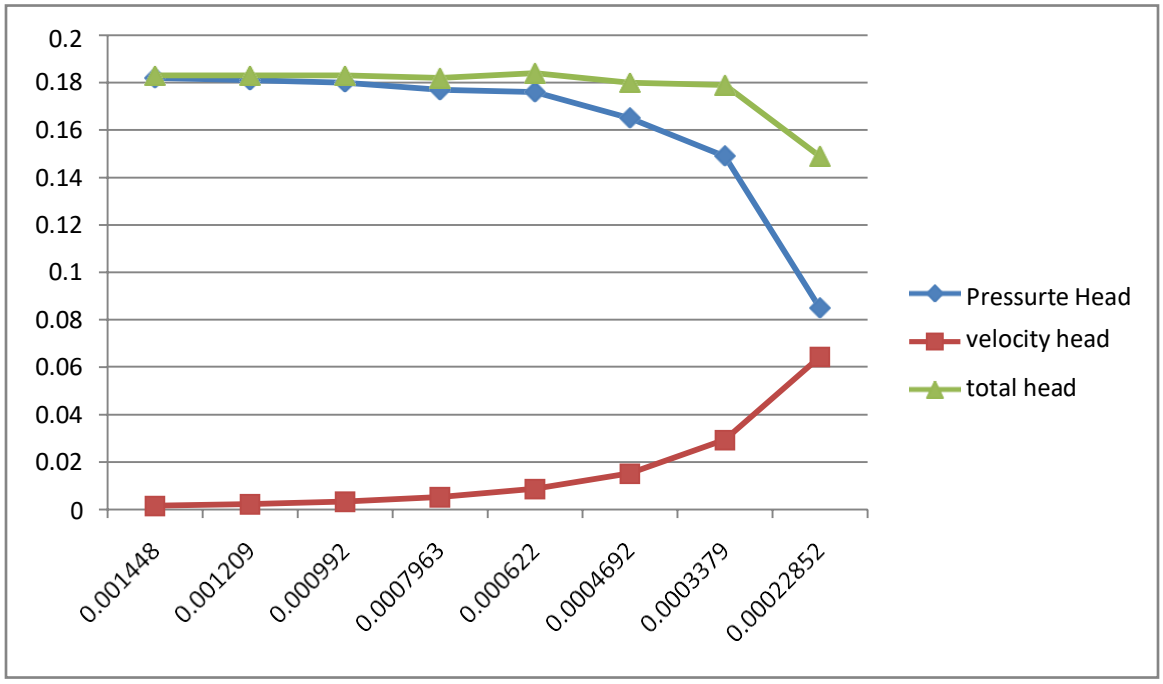
Velocity head,$(\frac{v2}{2g})\ 0.0016(m)$

Total head at the section, $(H = \frac{p}{w} + \frac{v^2}{2g})0.183(m)$

F. GRAPHS

Sample GRAPHS for understanding the variation of different heads with cross section

1. Pressure head vs Area of cross section (X – axis)
2. Velocity head vs Area of cross section (X – axis)
3. Total head vs Area of cross section (X – axis)



G.INFERENCES

H. PRECAUTIONS

1. Note down the readings without parallax.
2. No air bubbles are to be present in piezometers.

Determination of Coefficient of Discharge of Venturimeter

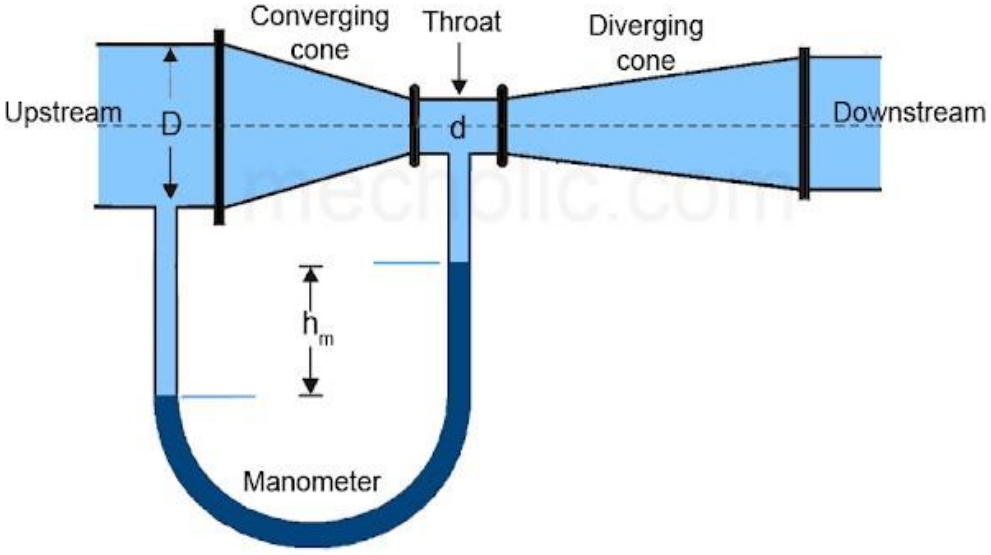
THEORY:

Venturimeter is a device used for measuring the rate of flow. It is consisting of two transforms of conical tubes joined by a short cylindrical section inserted in the pipe whose flow is to be measured. The basic principle on which the venturimeter works is that, by reducing the cross-sectional area of the flow passage a pressure difference is created and measurement of the pressure difference enables the determination of the discharge through the pipe.

The principle on which venturimeter is designed is based on the law of continuity of flow and Bernoulli's equation.

A. PROCEDURE

1 Measure the **diameter** of **inlet** (D) and the **throat** (d) of venturimeter. Ascertain the **mercury levels** in manometer limbs are **same.**
2. Measure the **internal dimensions** of the **collecting tank.**
3. **Open** the **control valve** and allow the water to flow through the pipe.
4. **Eject the air bubbles**, if any, by opening the air valve.
5. **Note** the **mercury levels** h_1 and h_2 in the two limbs of the manometer and hence $x=h_1-h_2$.
6. Close the outlet valve of measuring tank and **note** the **time taken** (T) in seconds **10 cm(H**) raise of water.
7. **Repeat** the process **5 times** and note the values for **different flow rates of water.**



B. OBSERVATIONS AND TABULATIONS

S. No.	Manometric readings of mercury in cm			pressure $h = x(\frac{sm}{s1}-1)$	Time for (10cm) raise of water in sec	Discharge (cm^3/sec)		Co-efficient of discharge, $Cd = \frac{Qa}{Qt}$
	h_1	h_2	Difference x= (h2 - h1)			Actual (Q_{act}) cm^3/sec	Theoretical (Q_{the}) cm^3/sec	
1.	9	24.8	15.8	199.08	8.13	1101.01	1146.34	0.96
2.	10	24.2	14.2	178.92	8.97	1003.34	1086.75	0.92
3.	10.5	23.6	13.1	165.06	9.13	985.76	1043.80	0.94
4.	11.5	22.9	11.4	139.104	9.78	920.24	958.21	0.96
5.	12.2	22.2	10	126	10.76	860.42	911.98	0.94

C.SPECIMEN CALCULATIONS

Area of the inlet, $a_1 = \pi /4(d)^2$

$= 0.785(2.5)^2 = 4.908\ cm^2$

Area of the throat, $a_2 = \pi /4(d)^2$

$=0.785(1.479)^2 = 1.718 cm^2$

Actual discharge, $Q_a \frac{AH}{t} = AH/T$

$= \frac{LBH}{T}$

$= \frac{30x30x10}{8.13}$

$Q_a = 1107.01\ cm^3/sec$

Theoretical discharge, $Q_t = \frac{a_1 a_2 \sqrt{2g}\sqrt{(a_1-a_2)^2 a_1 a_2}\sqrt{(2gh)}}{\sqrt{(a_1^2 - a_2^2)}}$

$= 1146.34 \text{ cm}^3/\text{sec}$

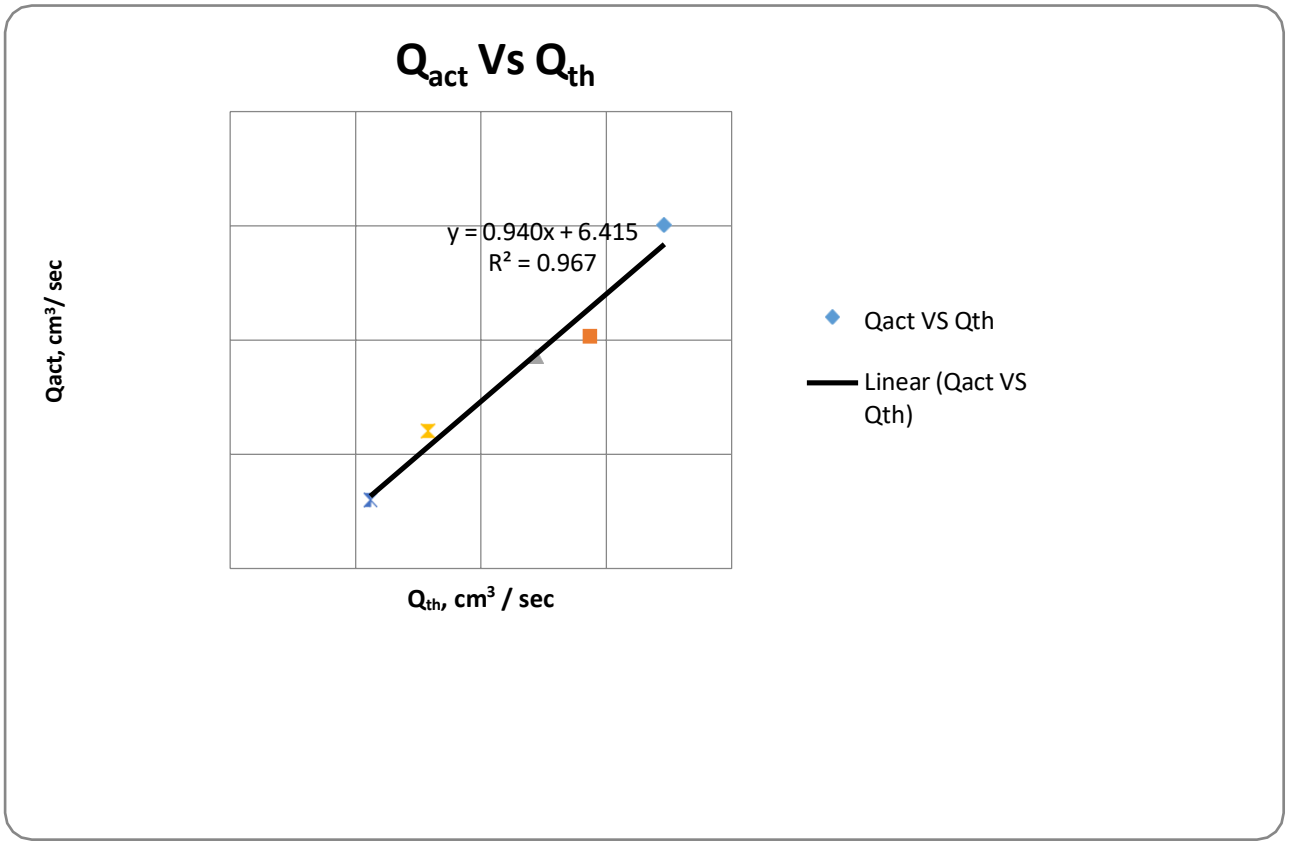
Co efficient of discharge, $Cd = \frac{Qa}{Qt}$

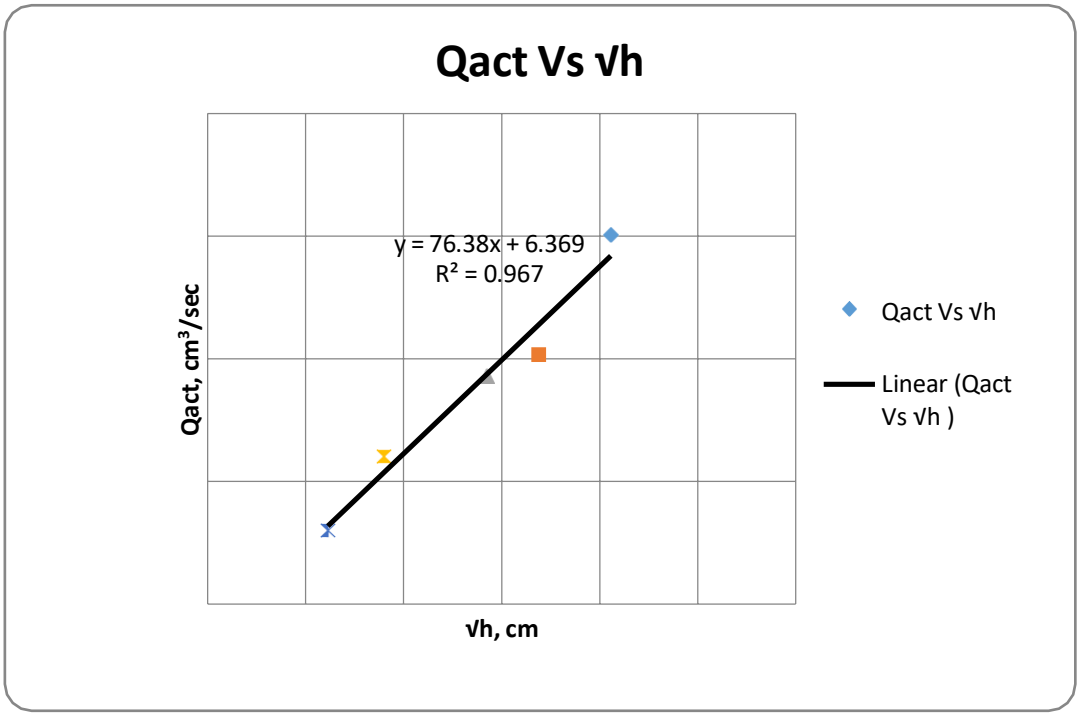
$=1107.01/1146.34$

$=0.965$

D.RESULT

Average value of Cd for Venturimeter = 0.944.




Qact Vs √h
y = 76.38x + 6.369
R² = 0.967
Qact, cm³/sec
√h, cm
Qact Vs √h
Linear (Qact Vs √h)

E.INFERENCE

DETERMINATION OF COEFFICIENT OF FRICTION OF PIPE

A. THEORY

When a fluid flows through a pipe line,it is subjected to frictional resistance. The frictional resistance depends upon the roughness of the inner surface of the pipe. More the roughness, greater the frictional resistance.

B. PROCEDURE

1. **Measure** the **diameter** of the **pipe**,the **internal plan dimensions** of **collecting tank**, and the **length** of the **pipe** between **pressure tapping cocks.**
2. **Keep** the **outlet valve fully closed** and the **inlet valve fully opened.**
3. **Note** the **mercury levels** in both the limbs. **Tightly close outlet valve** of **collecting tank** and note **time 'T' required** for **'H' rise** of water in a **collecting tank.**
4. **Repeat the above procedure with different flow rates and observing the corresponding readings.**
5. **Repeat** the **above procedure** for **other pipes** of different diameters.
6. The **observations** are **tabulated** then **friction factor** is **calculated.**

C. OBSERVATIONS AND TABULATIONS

S. No	Manometer reading in cm of Hg			Loss of head 'h_f' m of liquid	Time for10cm rise 'T' Sec	Discharge m^3/Sec	Velocity (m/sec)	Friction factor(f)
	h_1 cm	h_2 cm	X = (h_1-h_2) cm	=x($\frac{sm}{s1}$-1) /100		Q= AH/T	V=Q/a	
1	12.5	8.5	4	0.504	19.31	$9.32*10^{-4}$	2.968	0.0074
2	13.5	8.5	5	0.63	13.62	$1.32*10^{-3}$	4.207	0.00465
3	14.8	8.8	6	0.756	13.19	$1.36*10^{-3}$	4.34	0.00542
4	13.5	8.3	5.2	0.655	12.40	$1.45*10^{-3}$	4.621	0.004
5	13.8	7.8	6	0.756	12.06	$1.49*10^{-3}$	4.751	0.0043
Average value of f is								0.005154

D. CALCULATIONS

$$h_f = \frac{flv^2}{2gd}$$

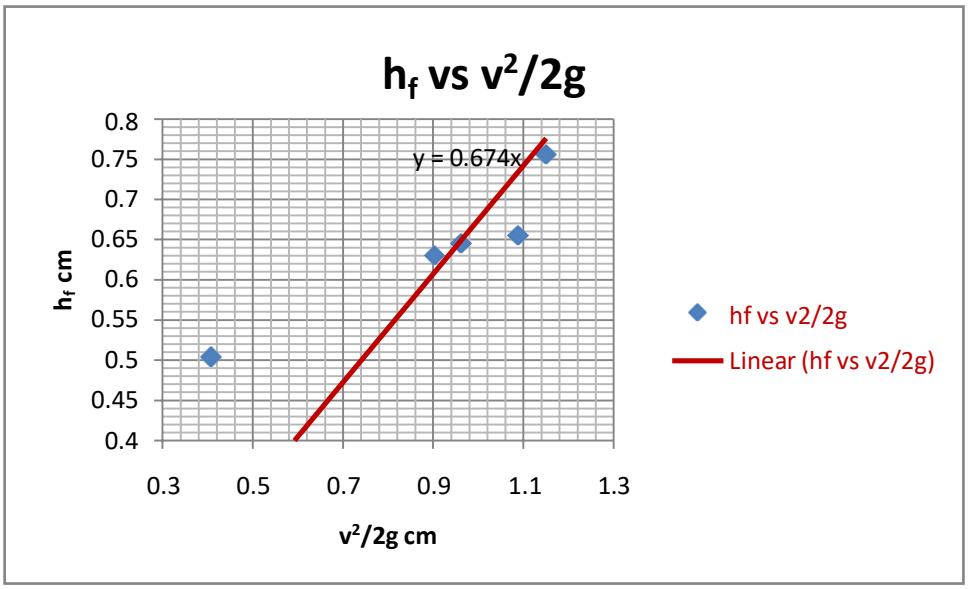
Area of colleting tank A = 0.3 x 0.6 = 0.18m^2.
Actual discharge Qa = AH/T = 0.18 x 0.1/19.31 = 0.000932 m^3/s.
Diameter of the pipe = 20mm.
Velocity in the pipe = Q/a = 0.000932 / 0.000314 = 2.968 m/s.
Length of the pipe = 3m
Friction factor f = (h_f * 2gd)/(lv^2) = 0.0074.

E.RESULT

Average friction coefficient is 0.00515.
From graph
Slope = $H_f/(v^2/2g)$ = 0.6747.
F = slope x d/L = 0.6747x0.02/3 = 0.0045.

F.Graph:

Head loss h_f vs Velocity head ($v^2/2g$)



G.INFERENCE

DETERMINATION OF CHEZY'S CONSTANT

A. PROCEDURE:

1. First **fill the water** in the **tank** of the apparatus.
2. **Set** the **slope of the flume (i)**.
3. **Note** the **width** of flow **(B)** i.e **width of channel in apparatus**
4. Note the **internal diameter** of the collecting tank
5. **Switch on** the **motor** to **start** the experiment (do priming if required).
6. **Operate inlet valve** to discharge water into the channel.
7. Wait for some time **to stabilise (to get steady flow)** the water level in the **flume**.
8. Measure the **depth of flow(y)** at **different locations (y_1,y_2&y_3)** of the flume .
9. Enter the **observations** in the **tabular form**.
10. **Close** the **valve** of **Collecting tank** and **note** down the **time taken** to fill the tank for 10cm rise in the water level. **Change** the slope / **discharge** and **repeat** the experiment for about **5 times** to get **Chezy's constant.**

B. OBSERVATIONS AND TABULATIONS

S. No.	Channel bed slope (i)	Time taken for 10cm rise (T)	Flow Rate Q_{act} = (AH/T)	Depth of flow				Area of flow A= (By)	Wetted perimeter (P) = B+2y	Mean radius (m) = A/P	Velocity (V) = Q_{act}/A	Chezy's constant C = V/√(m*i)
				Y_1	Y_2	Y_3	Y_{Avg}					
1	A											
2	B											
3	C											

C.SPECIMEN CALCULATIONS

A**verage depth** of flow $\mathbf{y_{avg}= (Y_1+Y_2+Y_3)/3}$
Area of flow $\mathbf{A=B*y_{avg}}$
wetted perimeter $\mathbf{P=B+(2*y_{avg})}$ **.**
Hydraulic radius m=A/P
A**ctual discharge** $\mathbf{Q_a=A*H/T}$
Velocity of flow V=Q_{act}/A
Chezy's constant C=$V/\sqrt{(m*i)}$

D.RESULT:

Chezy's

constant

E.INFERENCE

_____

_____

_____

_____

5. QUESTION PAPERS

5.1 UNIT TEST –I

Model Question Paper (C-20)

C-310 HYDRAULICS PRACTICE

TIME: 3 hours Total Marks: 60

Instructions : (1) Any one full question of the following shall be allotted to the students on lottery basis.

(2) All the questions are competency based and are for assessing the candidate's psychomotor skills

(3) Underpinning knowledge shall be assessed through viva voce - (6 M)

1. (A) Measure the dimensions of collecting tank in Orifice apparatus. **CO1**

(B) How do you operate stop watch for taking time required for descending specified height of water in orifice tank? **CO1**

(C) How do you maintain constant head in piezometer in mouthpiece apparatus? **CO1**

(5+20+29=54M)

2. (A) Measure the diameter of mouthpiece in mouthpiece apparatus. **CO1**

(B) Note down the time taken for specified rise of water level in collecting tank in verification of bernoulli's theorem apparatus **CO2**

(C) Maintain the constant head over the sill of rectangular notch in balancing tank. **CO1**

(10+19+25=54M)

3. (A) Measure the sill width of rectangular notch. **CO1**

(B) How do you operate stop watch for taking time required for collecting the specified height of water in collecting tank (venturimeter experiment)? **CO3**

(C) What are the precautions to be taken while taking the reading on the jet trajectory in orifice experiment for determining coefficient of velocity of the orifice. **CO1**

(10+20+24=54M)

4. (A) Measure the diameter of the orifice in orifice apparatus? **CO1**

(B) How do you convert the discharge units from cm^3/sec to m^3/sec. **CO1**

(C) How do you calculate coefficient of discharge of orifice using graph. **CO1**

(10+14+30=54M)

5. (A) what are the precautions do you take to avoid the overflow of orifice tank. **CO1**

(B) How do you coincide the hook gauge tip with water level in Rectangular notch apparatus. **CO1**

(C) How do you calculate coefficient of discharge of mouthpiece using graph. **CO1**

(12+12+30=54M)

5.2 UNIT TEST –II

Model Question Paper (C-20)

C-310 HYDRAULICS PRACTICE

TIME: 3 hours Total Marks: 60

Instructions : (1) Any one full question of the following shall be allotted to the students on lottery basis.

(2) All the questions are competency based and are for assessing the candidate's psychomotor skills

(3) Underpinning knowledge shall be assessed through viva voce -6 M

1. (A) Measure the angle of V-Notch. **CO1**

(B) Coincide the hook gauge tip with water level in Trapezoidal Notch apparatus. **CO1**

(C) Calculate the total head at any one piezometer point in verification of bernoullis theorem apparatus. **CO2**

(10+15+29=54M)

2. (A) Note down the diameter of pipe at different piezometer points in verification of bernoullis theorem apparatus. **CO2**

(B) Note down the differential U-Tube manometer reading in Venturimeter apparatus. **CO3**

(C) What are the factors affecting loss of head in flow through pipes. **CO3**

(12+17+25=54M)

3. (A) Identify the diameter of pipe and valves to be operated for measurement of differential pressure head in pipe friction apparatus. **CO3**

(B) How do you adjust the longitudinal bed slope of the channel to a particular value. **CO4**

(C) How do you maintain constant head in balancing tank of Trapezoidal notch apparatus. **CO1**

(12+18+24=54M)

4. (A) Identify and name any eight apparatus present in Hydraulics lab. **CO1**

(B) What is the significance of chezy's constant in open channel flow. **CO4**

(C) Given the observations pertaining to Triangular notch apparatus experiment.

Angle of notch (θ) = 60^0

Head of water tip (h) = 3.0 cm

Dimensions of collecting tank (LxB) = 60 cm x 30 cm

Time taken to collect (H=10cm) depth of water in collecting tank (T) = 113.6 sec

Calculate the value of coefficient of discharge. **CO1**

(12+18+24=54M)

5. (A) Note down the sill width and side slopes of Trapezoidal notch. **CO1**

(B) How do you note down the differential U-tube manometer reading without parallax. **CO3**

(C) How do you measure the discharge using V-Notch. **CO1**

(10+15+29=54M)

5.3 END EXAM (SEMESTER EXAM)

Model Question Paper (C-20)
C-310 HYDRAULICS PRACTICE

TIME: 3 hours Total Marks: 60

Instructions : (1) Any one full question of the following shall be allotted to the students on lottery basis.
(2) All the questions are competency based and are for assessing the candidate's psychomotor skills
(3) Underpinning knowledge shall be assessed through viva voce -4 M

1. (A) Measure the dimensions of collecting tank in Orifice apparatus. **CO1**

(B) How do you operate stop watch for taking time required for descending specified height of water in orifice tank? **CO1**

(C) Given the observations pertaining to Rectangular Notch experiment:

Plan Dimensions of Collecting Tank: L= 60 cm
B= 30 cm
Sill width of Rectangular Notch, b = 10 cm

S. No.	Hook gauge readings in cm		Head over sill of notch in 'cm' H=h2-h1	Time 'T' in 'sec' for h=10cm rise of water in collecting Tank	$H^{3/2}$	Actual discharge Q_a=Ah/T	Theoretical discharge (Q_{th})	Coefficient of discharge C_d= Q_a/Q_{th}
	Initial h1 (cm)	Final h2 (cm)	(cm)	(sec)		(cm^3/sec)	(cm^3/sec)	
1	0	2.2	2.2	27			---	---
2	0	3.8	3.8	12.2			---	---
3	0	5.7	5.7	8.31			---	---
4	0	5.9	5.9	6.82			---	---
5	0	6.3	6.3	6.03			---	---
						Average value of C_d=		---

Actual Discharge, Q_a = Ah/T
Theoretical Discharge, Q_{th} = (2/3).b.$\sqrt{(2g)}$. $H^{3/2}$

Calculate Coefficient of discharge of Rectangular notch using **graph**. **CO1**

2. (A) Measure the diameter of mouthpiece in mouthpiece apparatus. **CO1**

(B) Note down the time taken for specified rise of water level in collecting tank. **CO4**

(C) Given the observations pertaining to Mouthpiece by constant head method.

Diameter of mouth piece, d = 2.0 cm
Collecting tank plan dimensions, L= 30 cm,
B= 30 cm

S. No.	Constanthead (h) (cm)	Time for 10cm(H) rise of water level in collecting tank(T) (sec)	$\sqrt{h}$	Actual discharge Q_a=AH/T (cm^3/sec)	Theoretical discharge Q_{th}=a.√2gh (cm^3/sec)	Coefficient of discharge $C_d=Q_a/Q_{th}$
1	21	21.38			---	---
2	26	19.22			---	---
3	31	17.60			---	---
4	36	16.33			---	---
5	41	15.30			---	---
6	46	14.45			---	---
					Average C_d =	

Calculate Coefficient of discharge of Mouthpiece using **graph**. **CO1**

3. (A) Measure the sill width and Side slopes of Trapezoidal notch. **CO2**

(B) What are the precautions to be taken while taking the reading on the jet trajectory in orifice experiment for determining coefficient of velocity of the orifice. **CO1**

(C) The following observations are pertaining to small orifice by constant head method.

Diameter of the orifice, d = 1.50 cm
Plan Dimensions of collecting tank: L = 30 cm
B = 30 cm

S.No.	Head 'h' (cm)	Time for H=10cm rise of water level in collecting tank 'T' (sec)			$\sqrt{h}$	Discharge in (cm^3/sec)		Coefficient of Discharge $C_d=\frac{Qa}{Qth}$
		Trial		Average		$Q_a=\frac{AH}{T}$	$Q_{th}=a\sqrt{2gh}$	
		1	2	T (Sec)				
1	30	---	---	33.73			---	---
2	35	---	---	30.36			---	---
3	38	---	---	29.95			---	---

4	41	---	---	28.48			---	---
5	44	---	---	27.42			---	---
6	47	---	---	26.91			---	---
						Mean Value of C_d =		---

Calculate Coefficient of discharge of orifice using **graph**. **CO1**

4. (A) Measure the diameter of the orifice in orifice apparatus? **CO1**

(B) How do you convert the discharge units from cm^3/sec to m^3/sec. **CO3**

(C) Given the observations pertaining to Triangular Notch experiment:

Plan Dimensions of Collecting Tank: L= 60 cm
B= 30 cm

Angle of V-Notch, θ =60°

S. No.	Hook gauge readings in 'cm'		Head over tip of notch $H=h_2-h_1$ (cm)	Time 'T' in sec for h=10cm rise of water level in collecting tank (sec)	$H^{5/2}$	Actual discharge $Qa= Ah/T$ (cm^3/sec)	Theoretical discharge (Q_{th}) (cm^3/sec)	Coefficient of discharge $C_d= (Q_a/Q_{th})$
	Initial h_1 (cm)	Final h_2 (cm)						
1	0.6	3.6		113.6			---	---
2	0.6	5.4		38.19			---	---
3	0.6	6.9		20.59			---	---
4	0.6	7.8		15.12			---	---
5	0.6	9.4		9.10			---	---
							Average C_d=	---

Actual Discharge, $Q_a = Ah/T$

Theoritical Discharge, $Q_{th} = (8/15).\sqrt{(2g)}.\tan(\theta/2)\ H^{5/2}$

Calculate Coefficient of discharge of Triangular Notch using **graph**. **CO2**

5. (A) what are the precautions do you take to avoid the overflow of orifice tank. **CO1**

(B) How do you coincide the hook gauge tip with water level in Rectangular notch apparatus. **CO1**

(C) The following data pertaining to Venturimeter experiment:

Plan Dimensions of Collecting Tank: L= 30 cm
B= 30 cm

Diameter at inlet, d_1= 2.5 cm

Diameter of throat, d_2 = 1.479 cm

S. No.	Manometric readings (cm)			pressurehead (h) $=x\ (s_m/s_1-1)$ $= 12.6\ .x$ S_m=13.6 (for Mercury) S_1=1.0 (for water) (cm)	Time forH=10cm rise of water in collecting tank T (Sec)	Discharge (cm^3/sec)		Co-efficient of discharge, C_d= Qa/ Qth
	h_1 (cm)	h_2 (cm)	Difference x=(h_2 - h_1) (cm)			Actual Qa=AH/T (cm^3/sec)	Theoretical (Qth) (cm^3/sec)	
1	9.0	15.8			8.13			
2	10.0	14.2			8.97			
3	10.5	13.1			9.13			
4	11.5	11.4			9.78			
5	12.2	10.0			10.76			
							Average C_d=	

Calculate the value of coefficient of discharge of venturimeter using **graph.** **CO3**