I

Name _____

Roll No. _____ Year 20____20____

Exam Seat No. _____

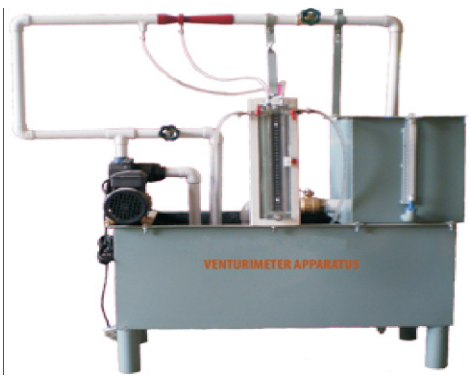
CIVIL GROUP | SEMESTER - IV | DIPLOMA IN ENGINEERING AND TECHNOLOGY

A LABORATORY MANUAL

FOR

HYDRAULICS

(22401)



MAHARASHTRA STATE BOARD OF TECHNICAL EDUCATION, MUMBAI

(Autonomous) (ISO 9001 : 2015) (ISO / IEC 27001 : 2013)

VISION

To ensure that the Diploma level Technical Education constantly matches the latest requirements of technology and industry and includes the all-round personal development of students including social concerns and to become globally competitive, technology led organization.

MISSION

To provide high quality technical and managerial manpower, information and consultancy services to the industry and community to enable the industry and community to face the changing technological and environmental challenges.

QUALITY POLICY

We, at MSBTE are committed to offer the best in class academic services to the students and institutes to enhance the delight of industry and society. This will be achieved through continual improvement in management practices adopted in the process of curriculum design, development, implementation, evaluation and monitoring system along with adequate faculty development programmes.

CORE VALUES

MSBTE believes in the followings:

- Education industry produces live products.
- Market requirements do not wait for curriculum changes.
- Question paper is the reflector of academic standards of educational organization.
- Well designed curriculum needs effective implementation too.
- Competency based curriculum is the backbone of need based program.
- Technical skills do need support of life skills.
- Best teachers are the national assets.
- Effective teaching learning process is impossible without learning resources.

A Laboratory Manual
for

Hydraulics

(22401)

Semester – (IV)

(CE, CR, CS)

Maharashtra State
Board of Technical Education, Mumbai
(Autonomous) (ISO 9001:2015) (ISO/IEC 27001:2013)

Maharashtra State Board of Technical Education,
(Autonomous) (ISO 9001 : 2015) (ISO/IEC 27001 : 2013)
4th Floor, Government Polytechnic Building, 49, Kherwadi,
Bandra (East), Mumbai - 400051.
(Printed on November 2018)

Maharashtra State
Board of Technical Education

Certificate

This is to certify that Mr. / Ms. …….
Roll No……. of Fourth Semester of Diploma in
…….of Institute
…….
(Code……..) has attained predefined practical outcomes (PROs) satisfactorily in course **Hydraulics (22401)** for the academic year 20…….to 20…..... as prescribed in the curriculum.

Place ……. Enrollment No……
Date:…..... Exam Seat No. ……..

Course Teacher **Head of the Department** **Principal**

Seal of the Institute

Preface

The primary focus of any engineering laboratory/ field work in the technical education system is to develop the much needed industry relevant competencies and skills. With this in view, MSBTE embarked on this innovative 'I' Scheme curricula for engineering diploma programmes with outcome-base education as the focus and accordingly, relatively large amount of time is allotted for the practical work. This displays the great importance of laboratory work making each teacher; instructor and student to realize that every minute of the laboratory time need to be effectively utilized to develop these outcomes, rather than doing other mundane activities. Therefore, for the successful implementation of this outcome-based curriculum, every practical has been designed to serve as a ***'vehicle'*** to develop this industry identified competency in every student. The practical skills are difficult to develop through 'chalk and duster' activity in the classroom situation. Accordingly, the 'I' scheme laboratory manual development team designed the practicals to ***focus*** on the ***outcomes***, rather than the traditional age old practice of conducting practicals to 'verify the theory' (which may become a byproduct along the way).

This laboratory manual is designed to help all stakeholders, especially the students, teachers and instructors to develop in the student the pre-determined outcomes. It is expected from each student that at least a day in advance, they have to thoroughly read through the concerned practical procedure that they will do the next day and understand the minimum theoretical background associated with the practical. Every practical in this manual begins by identifying the competency, industry relevant skills, course outcomes and practical outcomes which serve as a key focal point for doing the practical. The students will then become aware about the skills they will achieve through procedure shown there and necessary precautions to be taken, which will help them to apply in solving real-world problems in their professional life.

This manual also provides guidelines to teachers and instructors to effectively facilitate student-centered lab activities through each practical exercise by arranging and managing necessary resources in order that the students follow the procedures and precautions systematically ensuring the achievement of outcomes in the students.

The basic aim of hydraulics is to understand and control the occurrence, movement and use of water, for the benefit of society. To modify the behaviour of water, large investment of time, resources and efforts are required. It is necessary to study the behavior of static and moving water for the safety of water retaining structures like dams, percolation tanks, canals etc .The scope of hydraulics is in water resources department like irrigation, jeevan pradhikaran municipal corporations etc.

Although best possible care has been taken to check for errors (if any) in this laboratory manual, perfection may elude us as this is the first edition of this manual. Any errors and suggestions for improvement are solicited and highly welcome.

Programme Outcomes (POs) to be achieved through Practicals of this Course:-

PO 1. Basic knowledge: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.

PO 2. Discipline knowledge: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.

PO 3. Experiments and practice: An ability to plan and perform experiments and practices and to use the results to solve engineering problems.

PO 4. Engineering tools: Apply relevant civil technologies and tools with an understanding of the limitations.

PO 8. Individual and Team Work: Function effectively as leader and team member in Diverse /multidisciplinary team

PSO 1 Construction Planning and Designing: Perform optimal civil engineering construction, planning and designing activities of desired quality at optima cost.

PSO 2 Construction Execution and Maintenance: Execute civil engineering construction and maintenance using relevant materials and equipments

List of Industry Relevant Skills

- The following industry relevant skills of the competency '**Apply hydraulics principles in water carriage systems and water retaining structures.'** are expected to be developed in you by undertaking the practical of this laboratory manual.

.

a. Basic fluid properties in Civil Engineering contexts
b. Understand the relevance of hydraulics to the practice of civil engineering.
c. Interpret the pressure parameters from pressure measuring devices in flowing liquids.
d. Determine total hydrostatic pressure and centre of pressure in tanks.
e. Use relevant fluid flow parameters in flowing water.
f. Determine the loss of head of water flow through pipes and design pipe lines.
g. Design of open channels for given data.
h. Select relevant hydraulic pumps for given requirements.
i. Methods of measuring rate of fluid flow in pipes and open channels.

Practical- Course Outcome matrix

Course Outcomes (COs)

a. Interpret the pressure parameters from pressure measuring devices in flowing liquids.
b. Determine total hydrostatic pressure and centre of pressure for different conditions.
c. Use relevant fluid flow parameters in different situations.
d. Determine the loss of head of fluid flow through pipes.
e. Find the fluid flow parameters in open channels.
f. Select relevant hydraulic pumps for different applications.

S. No.	Practical Outcome	CO a.	CO b.	CO c.	CO d.	CO e.	CO f.
1	Compute the physical properties of given tap water and muddy water.	√	-	-	-	-	-
2	Compute the physical properties of given oil and Mercury	√	-	-	-	-	-
3	Use the piezometer to measure the pressure at a given point.	√	-	-	-	-	-
4	Use the Bourdon Gauge to measure the pressure at a given point.	√	-	-	-	-	-
5	Use the U tube differential manometer to measure the pressure difference between two given points.	√	-	-	-	-	-
6	Find the resultant pressure and its position for given situation of liquid in a tank.	-	√	-	-	-	-
7	Use the Reynold's apparatus to interpret type of flow.	-	-	√	-	-	-
8	Use the Bernoulli's apparatus to apply Bernoulli's theorem to get the total energy line for a flow in a closed conduit of varying cross sections.	√	-	√	-	-	-
9	Use the Friction factor Apparatus to determine friction factor for the given pipe.	√	-	-	√	-	-
10	Determine the minor losses in pipe fittings due to sudden contraction and sudden enlargement.	√	-	-	√	-	-
11	Determine the minor losses in pipe fitting due to Bend and Elbow.	√	-	-	√	-	-
12	Calibrate the Venturimeter to find out the discharge in a pipe.	√	-	-	√	-	-
13	Calibrate the Orifice to find out the discharge through a tank	√	-	-	-	√	-
14	Use the current meter to measure the velocity of flow of water in open channel.	-	-	-	-	√	-

15	Use the Pitot tube to measure the velocity of flow of water in open channel.	√	-	-	-	√	-
16	Use the Triangular notch to measure the discharge through open channel.	√	-	-	-	√	-
17	Use the Rectangular Notch to measure the discharge through open channel	√	-	-	-	√	-
18	Determine the efficiency of centrifugal pump.	√	-	-	-	-	√

Brief Guidelines to Teachers

Hints regarding strategies to be used:

1. For difficult practical if required, teacher could provide the demonstration of the practical emphasizing of the skills which the student should achieve.
2. Teachers should give opportunity to students for hands-on after the demonstration.
3. Teacher should give relevant information to students prior to visit arranged for effective utilization of time and understanding.
4. Teachers shall ensure that required equipment are in working condition before start each experiment, also keep operating instruction manual available.
5. There will be sheets of blank pages after every practical for the student to report other matters (if any), which is not mentioned in the printed practical.
6. Assess the skill achievement of the students and COs of each unit.
7. One or two questions ought to be added in each practical for different batches. For this teachers can maintain various practical related question banks for each course.
8. If some repetitive information like data sheet, use of software tools etc. has to be provided for effective attainment of practical outcomes, they can be incorporated in Appendix.
9. For effective implementation and attainment of practical outcomes, teacher ought to ensure that in the beginning itself of each practical, students must read through the complete write-up of that practical sheet.
10. During practical, ensure that each student gets chance and takes active part in taking observations/ readings and performing practical.
11. Teacher ought to assess the performance of students continuously according to the MSBTE guidelines.

Instructions for Students

1. For effective implementation and attainment of practical outcomes, in the beginning itself of each practical, students need to read through the complete write-up including the practical related questions and assessment scheme of that practical sheet.
2. Student ought to refer the data books, IS codes, Safety norms, internet websites etc.
3. Student should not hesitate to ask any difficulties they face during the conduct of practicals/visits.
4. Student should develop the habit of pear discussions/group discussion related to the experiment/exercise so that exchanges of knowledge /skills could take place.
5. Student shall attempt to develop related hands-on skills and gain confidence.
6. Students shall visit the nearby construction site, technical exhibitions, trade fair etc. even not included in the lab manual.
7. Students should develop the habit of not to depend totally on teachers but to develop self-learning techniques.
8. Student should develop habit to submit the practical exercise continuously and progressively on the scheduled dates and should get the assessment done
9. It is necessary to take all precautionary measures by students during site visit.
10. Students should take photographs (which may be different for each student) on their own for deep understanding of the concepts.

Content Page

List of Practicals and Progressive Assessment Sheet

Name of the Student- _____ Roll No. _____

Sr. No	Title of the Practical	Page No.	Date of Performance	Date of Submission	Assessment Marks (25)	Sign. of Teacher	Remarks (If Any)
12.*	Calibrate the Venturimeter to find out the discharge in a pipe.	84					
13.*	Calibrate the Orifice to find out the discharge through a tank.	92					
14.	Use the current meter to measure the velocity of flow of water in open channel.	100					
15.	Use the Pitot tube to measure the velocity of flow of water in open channel.	107					
16.*	Use the Triangular notch to measure the discharge through open channel.	114					
17.	Use the Rectangular Notch to measure the discharge through open channel.	121					
18.*	Determine the efficiency of centrifugal pump.	128					

Note: A judicial mix of minimum 12 or more more practical need to be performed , out of which practicals marked as * are compulsory.

Note: To be transferred to Proforma of CIAAN-2017.

Practical No. 1: Physical Properties of Tap Water and Muddy Water

I. Practical Significance

Physical properties of the liquids are to be understood and fluid characteristics have a crucial effect on equipment performance and life. Comparative study of liquids can be made after knowing their physical properties.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Interpret the pressure parameters from pressure measuring devices in flowing liquids.

IV. Practical Outcome

Compute the physical properties of given oil and Mercury.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Calculate the physical properties of the given liquid.
b. Compare two liquids based on their physical properties.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

Physical properties of liquids like specific mass, specific weight and Specific gravity and their SI units.

Specific mass (Mass density): It is the mass per unit volume. The unit of mass density is kg/m^3.

ρ for water = 1000 kg/m^3

$$\rho = \frac{\text{Mass}}{\text{Volume}} = \text{m/volume}$$

Specific weight or Unit weight or Weight density (γ): It is the weight per unit volume.

γ = weight of given liquid/weight of water at 4^0c

=W/volume

= mg/volume

$= \rho g$

Where, ρ is the mass density , g is the acceleration due to gravity

The unit of specific weight is N/m^3.

Weight density for potable water is 9810 N/m^3

Specific gravity or Relative density of a liquid (SL): It is the ratio of specific weight of liquid to the specific weight of pure water at 4^oC.

$$S_L = \frac{\text{Specific weight of liquid}}{\text{Specific weight of water at 4oC}}$$

$$S_L = \gamma_L / \gamma_{w,} \text{ or } S_L = \rho_L / \rho_w$$

Specific gravity has no units.

Specific gravity of potable water is "1".

VIII. Experimental Set-up

Figure 1. Measuring jar

Figure.2 Measuring jug

Figure 3. Digital weighing balance

IX. Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Volume measuring devices like measuring cup or graduated cylinder.	Standard make	**1**	For each batch
2	Digital weighing balance.	Standard make	**1**	For each batch

X. Procedure

1. Measure the volume of the given liquids using measuring jar or jug.
2. Measure the weight of the given liquids using digital weighing balance.
3. Find specific mass, specific weight and Specific gravity of the given liquids using formulae.

XI. Precautions to be followed

1. Measure the volume and weight accurately.
2. Handle mercury with care.

XII. Actual procedure followed *(Use blank sheet provided if space not sufficient)*

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV. Precautions followed

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XV. Observations and Calculations (Use blank sheet provided if space not sufficient)

Sr. No.	Mass (m)	Volume	Specific mass, ρ = mass / Volume	Specific Weight, γ_L = weight / Volume	Specific Gravity, $S_L = \gamma_L / \gamma_W$ or $= \rho_L / \rho_w$
1					
2					
3					

Sample Calculations:

1. **Specific mass, ρ = mass / Volume**

2. **Specific Weight γ_L = weight / Volume = w / g = mg / volume**
   Where, g is the acceleration due to gravity

3. **Specific Gravity S_L = = γ_L / γ_W**

$= \rho_L / \rho_w$

XVI. Results

Tap water:

1. Specific mass, $\rho_{\text{tap water}}$ = _____ kg/m^3
2. Specific Weight $\gamma_{\text{tap water}}$ =_____ N/m^3
3. Specific Gravity $S_{\text{tap water}}$ =_____

Muddy water :

1. Specific mass, $\rho_{\text{muddy water}}$ = _____ kg/m^3
2. Specific Weight $\gamma_{\text{muddy water}}$ =_____ N/m^3
3. Specific Gravity $S_{\text{muddy water}}$ =_____

XVII. Interpretation of results*(Give meaning of the above obtained results)*

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XVIII. Conclusions and Recommendations (if any)

(Actions/decisions to be taken based on the interpretation of results).

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XIX. Practical Related Questions

Note: *Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the capacity of the measuring cylinder used.
2. State the maximum weighing capacity of digital balanced used.
3. State the least count of the digital balance used
4. Compare two given liquids based on specific gravity.

[Space to Write Answers]

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan,R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links: https://www.youtube.com/watch?v=A0BuHEqDm88

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related: 15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related: 10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total : 25 Marks		**100%**

List of Student Team Members

1……

2…….

3…….

4…….

Marks Obtained			Dated Signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 2: Physical Properties of Oil and Mercury

I. Practical Significance

Physical properties of the liquids are to be understood and fluid characteristics have a crucial effect on equipment performance and life. Comparative study of liquids can be *made after knowing their physical properties.*

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Interpret the pressure parameters from pressure measuring devices in flowing liquids.

IV. Practical Outcome

Compute the physical properties of given oil and Mercury.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Calculate the physical properties of the given liquid.
b. Compare two liquids based on their physical properties.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

Physical properties of liquids like specific mass, specific weight and Specific gravity and their SI units.

Specific mass (Mass density): It is the mass per unit volume. The unit of mass density is kg/m^3.

ρ for water = 1000 kg/m^3

$$\rho = \frac{\text{Mass}}{\text{Volume}} = \text{m/volume}$$

Specific weight or Unit weight or Weight density (γ): It is the weight per unit volume.

γ = weight of given liquid/weight of water at 4^0c

=W/volume

= mg/volume

$= \rho g$

Where, ρ is the mass density , g is the acceleration due to gravity

The unit of specific weight is N/m^3.

Weight density for potable water is 9810 N/m^3

Specific gravity or Relative density of a liquid (S_L): It is the ratio of specific weight of liquid to the specific weight of pure water at 4oC.

$$S_L = \frac{\text{Specific weight of liquid}}{\text{Specific weight of water at 4oC}}$$

$$S_L = \gamma_L / \gamma_W, \quad \text{or} \quad S_L = \rho_L / \rho_w$$

Specific gravity has no units.

Specific gravity of potable water is "1".

VIII. Experimental Set-up

Figure 1. Measuring jar

Figure 2.Measuring jug

Figure 3. Digital weighing balance

IX. Resources required

Sr. No	Particulars	Specification	Qty.	Remark
1	Volume measuring devices like measuring cup or graduated cylinder.	Standard make	1	For each batch
2	Digital weighing balance.	Standard make	1	For each batch

X. Procedure

1.Measure the volume of the given liquids using measuring jar or jug.
2.Measure the weight of the given liquids using digital weighing balance.
3.Find specific mass, specific weight and Specific gravity of the given liquids using formulae.

XI. Precautions to be followed

1. Measure the volume and weight accurately.
2. Handle mercury with care.

XII. Actual procedure followed *(Use blank sheet provided if space not sufficient)*

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					
4					

XIV. Precautions followed

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XV. Observations and Calculations (Use blank sheet provided if space not sufficient)

Sr. No.	Mass (m)	Volume	Specific mass, ρ = mass / Volume	Specific Weight, γ_L = weight / Volume	Specific Gravity, $S_L = \gamma_L / \gamma_W$ or $= \rho_L / \rho_w$
1					
2					
3					

Sample Calculations:

3. **Specific mass, ρ = mass / Volume**

4. **Specific Weight γ_L = weight / Volume = w / g = mg / volume**
   Where, g is the acceleration due to gravity

3. **Specific Gravity S_L = = γ_L / γ_W = ρ_L / ρ_w**

XVI. Results

Oil :

1. Specific mass, ρ_{oil} = _____ kg/m^3
2. Specific Weight γ_{oil} =_____N/m^3
3. Specific Gravity S_{oil} =_____

Mercury:

1. Specific mass, $\rho_{mercury}$ = _____ kg/m^3
2. Specific Weight $\gamma_{mercury}$ =_____ N/m^3
3. Specific Gravity $S_{mercury}$ =_____

XVII. Interpretation of results*(Give meaning of the above obtained results)*

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XVIII. Conclusions and Recommendations if any

(Actions/decisions to be taken based on the interpretation of results).

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XIX. Practical Related Questions

Note: *Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the capacity of the measuring cylinder used.
2. State the maximum weighing capacity of digital balanced used.
3. State the least count of the digital balance used
4. Compare two given liquids based on specific gravity.
5. Name the oil used during the experiment.

[Space to Write Answers]

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XX References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan,R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links:

1. https://www.youtube.com/watch?v=A0BuHEqDm88

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related: 15 Marks		**60%**
1	Performing the test/Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related: 10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total : 25 Marks		**100%**

List of Student Team Members

1…….

2……..

3……..

4……..

Marks Obtained			Dated Signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 3: Pressure Measurement by Piezometer

I. Practical Significance

A piezometer is a device used to measure liquid pressure at a point in a system by measuring the height to which a column of the liquid rises against gravity. A piezometer is designed to measure static pressure.

II. Relevant Program Outcomes (POs)

PO 1. *Basic knowledge: An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5.. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Interpret the pressure parameters from pressure measuring devices in flowing liquids.

IV. Practical Outcome

Use the piezometer to measure the pressure at a given Point.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Measure the pressure at a point in the given flow using piezometer.
b. Understand the limitations of piezometer.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

1.Piezometer consists of a transparent glass tube, inserted at a point in the wall of a vessel or of a pipe where pressure is to be measured. The tube extends vertically upward to such a height that liquid can freely rise in it without overflowing. The pressure at any point in the liquid is indicated by the height of the liquid in the tube above that point.

2. Calculate the pressure of the liquid at a point using formula for Piezometer.

$p = \gamma_L h$ where p-= intensity of pressure,

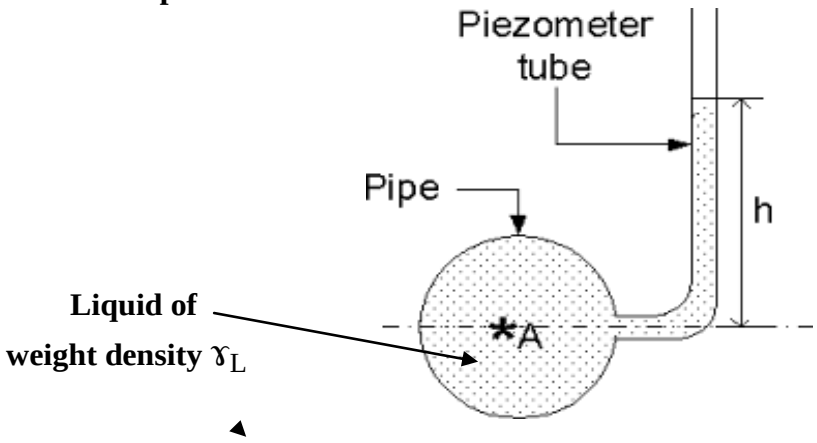
h= rise of liquid in piezometer in and

γ_L = Specific weight of the liquid

Limitations in the use of piezometer-

- Piezometres can not measure very high or low pressure.it can measure only moderate pressure.
- Piezometres can not measure negative pressure.
- Piezometres can not measure gas pressure.

VIII. Experimental Set-up



$p_A = \gamma_L h$

Figure 1. Piezometer

IX. Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Piezometer	Standard make	1	For each batch

X. Procedure

1. Open the valve and start fluid flow in the pipe.
2. Observe the glass tube connected to pipe through which the liquid is flowing
3. Note the height of water in the glass tube on the scale attached to it.
4. Calculate intensity of pressure at the point, $p = \gamma_L h$.
5. Repeat the experiment by changing the fluid flow using the valve.

XI. Precautions to be followed

1. Use the apparatus carefully.
2. Observe the readings with precision.

XII. Actual procedure followed (To be written by students)

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
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3					

XIV. Precautions followed

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XV. Observations and Calculations (Use blank sheet provided if space not sufficient)

Sr. No.	Rise in water level in the piezometer, Pressure head (h)	Pressure intensity ($p = \gamma_L h$)
1		
2		
3		

Sample calculations: $p = \gamma_L h$. Where p = Pressure intensity at the point

γ_L = Specific weight of the liquid,

h= Piezometric head

XVI. Results

Pressure intensity at the given point using piezometer is

1. = _____ N/m^2
2. = _____ N/m^2
3. = _____ N/m^2

XVII. Interpretation of results (Give meaning of the above obtained results)

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XVIII. Conclusions and Recommendations if any *(Actions/decisions to be taken based on the interpretation of results).*

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XIX. Practical Related Questions

Note: *Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the length of the piezometer used during practical.
2. State the limitations in the use of piezometer.
3. State the equation used to find the pressure using piezometer.
4. Comment on the diameter of piezometer to be used on measurement.
5. Name all the instruments where piezometer is fitted in laboratory.

[Space to Write Answers]

XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan, R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links:

1. https://www.youtube.com/watch?v=_VDVi_zq3nk
2. https://www.youtube.com/watch?v=s13pakJrcqk

XI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the test/ Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total: 25 Marks		**100%**

List of Student Team Members

1…….

2…….

3……..

4……..

	Marks Obtained		Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 04: Bourdon's Pressure Gauge to Measure The Pressure at a Point.

I. Practical Significance

Bourdon pressure gauge is mechanical device used to measure the pressure of a liquid/gas at a point. The Bourdon pressure gauge uses the principle that a flattened tube tends to straighten or regain its circular form in cross-section when pressurized.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Interpret the pressure parameters from pressure measuring devices in flowing liquids.

IV. Practical Outcome

Use Bourdons pressure gauge to measure the pressure at a given Point.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Measure the pressure at a point using Bourdon's pressure gauge.
b. Understand the working of Bourdon's pressure gauge.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

The Bourdon pressure gauge uses the principle that a flattened tube tends to straighten or regain its circular form in cross-section when pressurized. This change in cross-section may be hardly noticeable, involving moderate stresses within the elastic range of easily workable

materials. The strain of the material of the tube is magnified by forming the tube into a C shape or even a helix, such that the entire tube tends to straighten out or uncoil elastically as it is pressurized.

VIII. Experimental Set-up

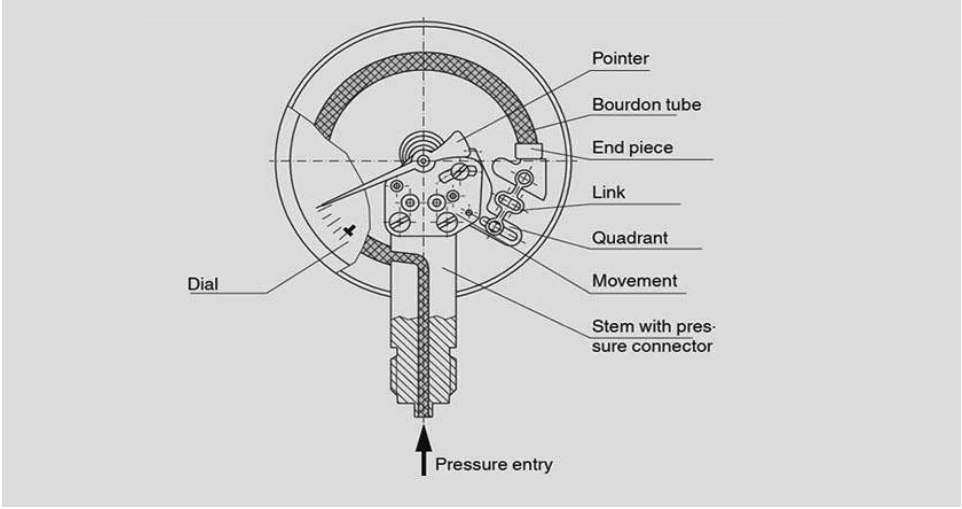

Figure 1. ***Bourdon's Pressure gauge***

IX. Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Bourdon's pressure gauge	Standard make	1	For each batch

X. Procedure

1. Start fluid flow in the pipe line by opening the valve.
2. Note the units indicated on the Bourdon's pressure gauge.
3. Note the least count of the Bourdon's pressure gauge.
4. Observe and note the magnitude of the pressure.
5. Repeat the experiment by rotating the valve to 2-3 different position and take the reading of the pressure gauge.

XI. Precautions to be followed

1. Use the apparatus carefully.
2. Observe the readings with precision.

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
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2					
3					

XIV. Precautions followed

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XV. Observations and Calculations (Use blank sheet provided if space not sufficient)

Sr. No	Observed pressure intensity(p) in N/m^2
1	
2	
3	

XVI. Results

a. Least count of the Bourdon's pressure gauge is _____ .

b. Pressure intensity at the given point is _____ .

i. _____ N/m^2

ii. _____ N/m^2

iii. _____ N/m^2

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XVII. Interpretation of results (Give meaning of the above obtained results)

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XVIII. Conclusions and Recommendations if any *(Actions/decisions to be taken based on the interpretation of results).*

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XIX. Practical Related Questions

Note: *Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the make of the Bourdon's pressure gauge.
2. How does Bourdon's tube pressure gauge works.
3. State the least count of the Bourdon's pressure gauge.
4. Draw a neat sketch of the Bourdon's pressure gauge and label.
5. State the practical situations in day to day life where you observe /use the gauge.
6. What Zero of Bourdon's pressure gauge indicates?can it measure negative pressure?

[Space to Write Answers]

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
3	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
4	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan,R.	Dhanpat Rai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links:

1. https://www.youtube.com/watch?v=w0bIxKB8maw
2. https://www.youtube.com/watch?v=dPfLX8siEwU

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total: 25 Marks		**100%**

List of Student Team Members

1…….

2…….

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Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 05: U Tube Differential Manometer

I. Practical Significance

Pressure difference between the two points is essential to decide the direction of flow. Differential manometers are also used to compare the pressure of two different containers. They reveal both which container has greater pressure and how large the difference between the two is.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO8. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Interpret the pressure parameters from pressure measuring devices in flowing liquids.

IV. Practical Outcome

Use the U tube differential manometer to measure the pressure difference between two given points.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency. **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Measure high pressure difference between two points in same or different pipe lines.

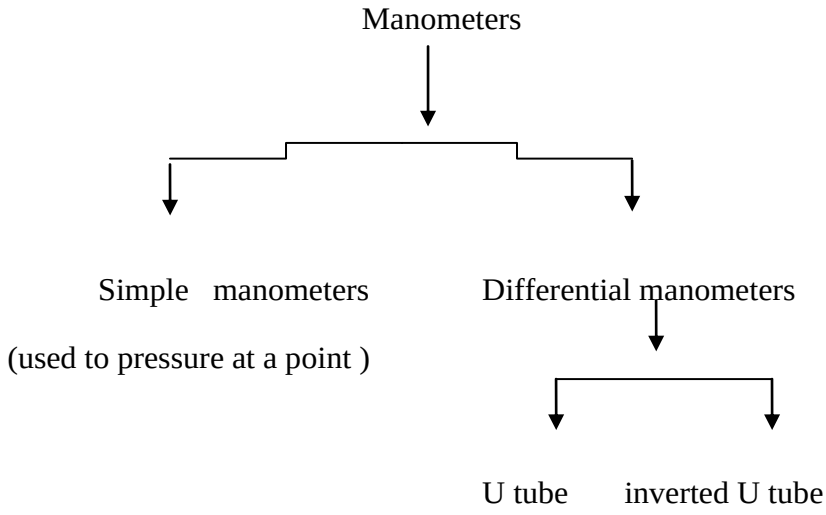
VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

Manometer are pressure measuring devices generally used in laboratory. Manometers overcome the limitations in the use of piezometers. Manometers can measure high, low, negative pressure of liquids and gases. The only disadvantage of manometers is that they are not easy to carry or transport. Mercury is used as manometric liquid in simple and U tube differential manometers where in inverted U tube manometer "the fluid which is lighter than the fluid flowing through the pipe line can be used as manometric fluid."

The classification is shown below.



Calculate the pressure of the liquid at a point.

$P = \gamma h$

Where ,

p = intensity of pressure,

h = rise of liquid in piezometer and

γ = Specific weight of the liquid

A differential U tube manometer is a device used to measure the difference in pressure between two points of the same or different pipe lines. It consists of a U tube containing heavy liquid and its two ends are connected to the points whose difference of pressure is required to be measured.

VIII. Experimental Set-up

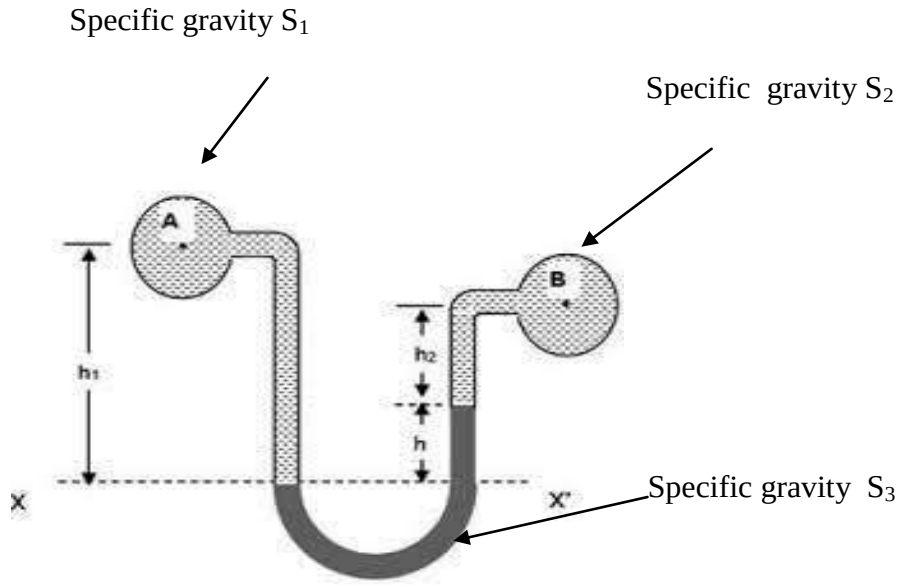


Figure 1: ***Differential U tube manometer***

$$\frac{P_A}{\gamma} + h_1 S_1 = \frac{P_B}{\gamma} + h_2 S_2 + h S_3$$

$$\frac{P_A}{\gamma} - \frac{P_B}{\gamma} = h_2 S_2 + h S_3 - h_1 S_1$$

$$(H_A - H_B) = h_2 S_2 + h S_3 - h_1 S_1$$

IX. Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	U tube differential manometer	Standard make	**1**	For each batch

X. Procedure:

1. Start the fluid flow in pipe by opening the valve.
2. Observe the manometer connected to pipe through which liquid is flowing.
3. Note the difference of heavy liquid in U tube.
4. Note the distance of center of pipe from heavy liquid in the right limb and left limb.
5. Calculate the difference of pressure head at A and B.
6. Calculate the difference of pressure intensities.
7. Repeat the experiment by changing the rate of flow by operating the valve.

XI. Precautions to be followed

1. Use the apparatus carefully.
2. Observe the readings with precision.
3. Handle mercury with care.

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
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2					
3					

XIV. Precautions followed

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XV. Observations and Calculations (Use blank sheet provided if space not sufficient)

Specific gravity of liquid flowing in pipe A, S_1 =_____

Specific gravity of liquid flowing in pipe B , S_2 =_____

Specific gravity of manometric liquid , S_3 =_____

Sr. No.	Manometer readings			Formula $H_A - H_B = S_3h + S_2h_2 - S_1h_1$	Pressure difference= $p_A - p_B = \gamma_A (h_A - h_B)$
	h_1	h_2	H		
1					
2					
3					

Sample Calculation:

i. $H_A - H_B = S_3h + S_2h_2 - S_1h_1$

ii. $P_A - P_B = \gamma (h_A - h_B)$

VI. Results

Pressure difference = $P_A - P_B$ =

4. = _____N/m^2
5. = _____N/m^2
6. = _____N/m^2

XVI. Interpretation of results (Give meaning of the above obtained results)

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XVII. Conclusions and Recommendations (If any)

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XVIII. Practical Related Questions

Note: *Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the principle on which Differential U tube manometer works.
2. Name the liquid flowing in the pipe line and its specific gravity.
3. Write the situation when inverted manometers are used.
4. Mercury is used as manometric liquid. Give reasons.
5. Mercury does not stick to the walls of the manometer. Give reasons.
6. Draw and write the formula /expression for calculating pressure difference when both the pipes are at the same level, with the same and different liquids flowing in the pipes.
7. With the help of neat diagram show positive and negative pressure at a point .in a simple U tube manometer.
8. Name the equipment where differential manometer is used.

[Space to Write Answers]

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XIX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan, R.	DhanpatRai Publishing Company, Nev Delhi, **ISBN:**8187433841

Suggested links:

1. https://www.youtube.com/watch?v=WmWw_IB6nv4
2. https://www.youtube.com/watch?v=zvc_hRg-0Ns

XX. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total : 25 Marks		**100%**

List of Student Team Members

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2…….

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Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 06: Resultant Pressure and Its Position for a Liquid in a Tank

I. Practical Significance

Pressure exerted by the liquid on the walls and the base of the container is important while designing the containers. The stability of the containers depends on the total pressure exerted on them. In this experiment pressure exerted by the liquid on the walls and the base of the container is determined.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Determine total hydrostatic pressure and center of pressure for different conditions.

IV. Practical Outcome

Find the resultant pressure and its position for given situation of liquid in a tank.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Determine total hydrostatic pressure at base and on the sides of the tank.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

1. Calculate the pressure of the liquid at a point using formula for Piezometer.
   Hydrostatic pressure (total pressure) is the pressure exerted by a fluid which is at rest on the surface with which fluid is in contact. Hydrostatic pressure increases in proportion to depth measured from the free liquid surface Total pressure is always perpendicular to the surface with which the fluid is in contact. Unit of total pressure is "N
2. Centre of pressure is the point where the total hydrostatic pressure acts.
3. Center of pressure is always below the center of gravity of the body/surface.

VIII. Experimental Set-up

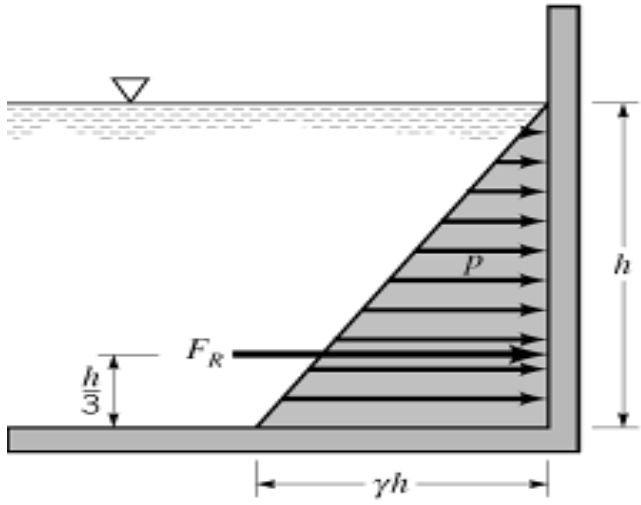

Figure 1. Hydrostatic force acting on the wall of a tank

IX. Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Tank containing liquid	Standard make	1	For each batch

X. Procedure

1. Measure the area of the tank by knowing its length(L) and width(B).
2. Fill the tank up to certain height.
3. Note the piezometric reading and record the pieozometric head h.
4. Calculate the pressure intensities on the walls and the base of the container.
5. Find the position of centre of pressure.
6. Experiment is repeated for different heads of liquid in the tank.

XI. Precautions to be followed

1. Use the apparatus carefully.
2. Observe the readings with precision.

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
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2					
3					

XIV. Precautions followed

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XV. Observations and Calculations (Use blank sheet provided if space not sufficient)

1. Area of the tank = A= L x B = _____m^2.
2. Specific gravity of Liquid in tank, S_1 =_____ .

Sr No	Piezometric Head, h	Total Hydrostatic pr. on the base, of the tank $P_1 = \gamma_L A h$	Total Hydrostatic pr.on the wall, of the tank $P_2 = ½ \gamma_L h^2$
1			
2			
3			

Sample calculations

1. $\gamma_L = \rho \times g$

   $P = w A h = \gamma_L A h$

   Where, γ_L= weight density of liquid

   g = gravitational acceleration

   A = area of Bottom of tank

   h = Head of water above the base.

2. Piezometric head in the tank = h =

3. Total Hydrostatic pressure on the base, $P_1 = \gamma_L A h$ =

4. Total Hydrostatic pressure on the wall, $P_2 = ½ \gamma_L h^2$ =

XVI. Results

Total Hydrostatic pressure on the base, P_1

a. _____ N
b. _____ N
c. _____ N

Total Hydrostatic pressure on the Wall, P_2

a. _____ N
b. _____ N
c. _____ N

XVII. Interpretation of results (Give meaning of the above obtained results)

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XVIII. Conclusions and Recommendations (if any)

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XIX. Practical Related Questions

1. State the volume of the tank used.
2. Mention the specific gravity of the liquid in the tank.
3. Is the total hydrostatic pressure acting on the wall and the base are same or not? Give reasons
4. Define center of pressure.
5. Draw pressure diagrams for the following cases
   a. Pressure due to one type of liquid on the side of the surface.
   b. Pressure due to different types of liquids one over another on one side of the tank only.
   c. Resultant Pressure acting on the wall due to liquids of same or different specific gravity on both sides of wall.

[Space to Write Answers]

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan, R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links:

1. https://www.youtube.com/watch?v=-BB-bCE8klg

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related: 15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related: 10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total : 25 Marks		**100%**

List of Student Team Members

1 ……..

2 ……..

3. …….

4.. ……

5. …….

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 07: Reynolds's Apparatus

I. Practical Significance

Deciding the type of flow is required to design the conduits. There are different types of flows; Steady, Unsteady, Uniform, Non-uniform, Laminar and turbulent flow etc. In this experiment we will be able to differentiate the laminar and turbulent flow both through observation and calculations.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Use relevant fluid flow parameters in different situations.

IV. Practical Outcome

Use the Reynold's apparatus to interpret the type of flow.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Understand the type of flow both by observation and calculations.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

1. In fluid dynamics, laminar flow is a flow in which fluid particles do not cross each others path. It occurs when a fluid flows in parallel layers, with no disruption between the layers. At low velocities, the fluid tends to flow without lateral mixing and adjacent layers slide past one another like playing cards.

2. Turbulent flow is the type of fluid flow in which the fluid particles move in a zigzag manner. In turbulent flow the speed of the fluid at a point is continuously undergoing changes in both magnitude and direction.
3. Reynold's number is a dimensionless number (no units) used in fluid mechanics to indicate whether fluid flow is laminar or turbulent.
4. Reynold's number values is different for open channel and pipe flow.
5. Re = $\rho vD/\mu$ where ρ = mass density, v = velocity of flow, D= diameter the pipe, μ = coefficient of friction

VIII. Experimental Set-up

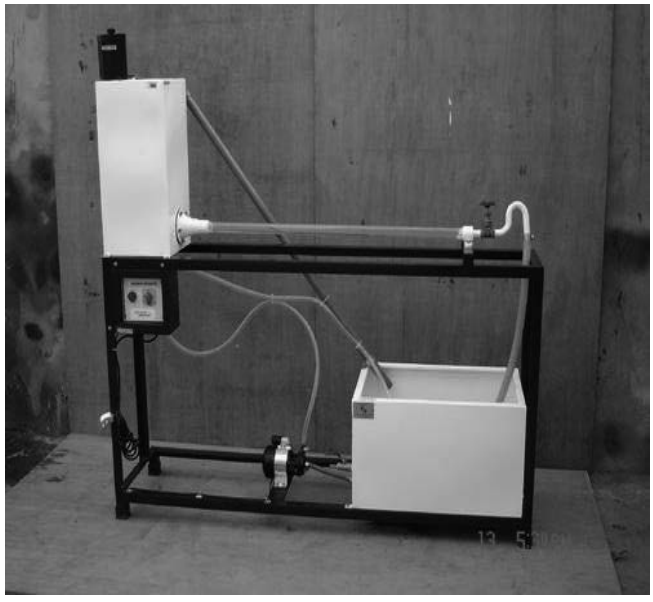

Figure 1. Reynold's Apparatus

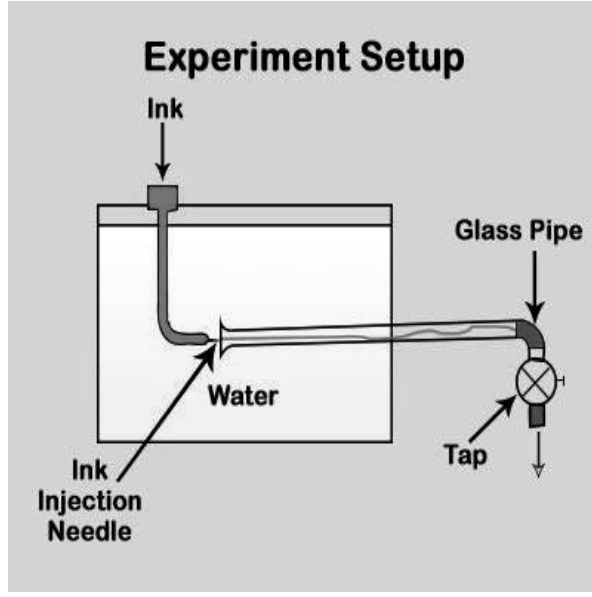

Figure 2. Line diagram of set-up

IX. Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Reynold's apparatus	Standard make	1	For each batch

X. Procedure

1. Note the diameter of the pipe.
2. Fill the tank with water by keeping outlet of glass tube partly opened so that no air is entrapped in the glass tube.
3. When the tank is full, close the outlet valve of glass tube and inlet valve of the tank.
4. Allow the water in the tank to come to the state of rest.
5. Maintain constant level of water by opening both inlet valve.
6. Allow the dye from the dye ejector in to the flow.
7. Allow a certain volume of water to be collected in the measuring tank, note time of collection of water and compute the discharge.

8. Gradually increase the velocity of flow and measure the discharge.
9. Repeat the readings till dye get dispersed in the flow of water.
10. Repeat the experiment with the varying the rate of flow.

XI. Precautions to be followed

1. Use the apparatus carefully.
2. Observe the readings with precision

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
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XIV. Precautions followed

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XV. Observations and Calculations (Use blank sheet provided if space not sufficient)

1. Inner diameter of the glass tube, D =_____m.
2. C/S area of the glass tube =A= $\pi D^2/4$ = _____m^2
3. Mass density of water $\rho_w = 1000 kg/m^3$ = _____
4. Dynamic viscosity of water, μ =_____ $N.s/m^2$.
5. Area of Tank = L x B =_____ m^2
6. Name of the dye used =_____

Run no	Volume, m^3	Time (T) sec	Discharge Q= Volume /Time	Velocity, V= Q/A	Re = $\rho vD/\mu$	Type of flow In pipe
1						
2						
3						

Sample calculations

1. Discharge, Q= Volume / Time

2. Velocity, V= Q/A

3. Re= $\rho vD/\mu$

XVI. Results

Reynold's number, Re and type of flow,

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XVII Interpretation of results (Give meaning of the above obtained results)

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XVIII Conclusions and Recommendations (if any)

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XVII. Practical Related Questions

Note: *Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. Name the dye used in the experiment.
2. Give two practical examples for laminar and turbulent flow.
3. Name two dyes used in Reynold's experiment.
4. State the values of Reynold's number for laminar, turbulent and transition flow through pipes and channels.

[Space to Write Answers]

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XVIII. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan, R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links :

a. https://www.youtube.com/watch?v=pae5WrmDzUU
b. https://www.youtube.com/watch?v=upHHx42r4E0

XIX. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total: 25 Marks		**100%**

List of Student Team Members

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Marks Obtained			Dated Signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 08: Verify Bernoulli's Theorem

I. Practical Significance

The significance of Bernoulli's principle can be summarized as total head is constant along a streamline. The sum of potential energy, kinetic energy and pressure energy is constant on every streamline provided no energy enters or leaves the system. This principle is used in various instruments to measure the rate of flow.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Use relevant fluid flow parameters in different situations.

IV. Practical Outcome

Use the Bernoulli's apparatus to verify Bernoulli's theorem to get the total energy line for a flow in a closed conduit of varying cross sections.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Determine total energy at a section in a pipe flow.
b. Draw total energy line.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

Bernoulli's theorem states that in an ideal, incompressible fluid, when the flow is steady and continuous, the sum of pressure energy, kinetic energy and potential energy is constant along a stream line.

Potential energy: Potential energy is the energy possessed by the fluid/object because of its position with respect to some arbitrary horizontal datum plane.

The potential energy per unit weight = Z, in metres.

Kinetic energy: It is the energy possessed by a liquid by virtue of its motion. Suppose a liquid of weight W is moving at a velocity V metres/second.

K.E. = ½ mV^2

Pressure energy: When the liquid is in motion, it is under some pressure. This pressure is converted into equivalent height of liquid.

h =P/ γ_L, γ_L = being specific weight of liquid.

VIII. Experimental Set-up

Figure 1. Bernoulli's Apparatus

IX. Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Bernoulli's apparatus	Standard make	1	For each batch

X. Procedure:

1.Find the area of the measuring tank by measuring length (L) and width (B).
2.Note the area of piezometers at various gauge points.

3.Open the supply valve and adjust the flow so that the water level in the inlet tank remains constant.
4.Measure the height of water level in different piezometric tubes.
5.Measure the discharge of conduit with help of measuring tank.
6.Repeat the steps 3 to 5 for two more readings.
7.Plot the graph between the total head and distance of gauge point starting from the upstream side of the conduit.

XI. Precautions to be followed

1. Use the apparatus carefully.
2. Observe the readings with precision.
3. Adjust the flow so that the water level in the inlet tank remains constant.

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
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XIV. Precautions followed

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XV. Observations and Calculations (Use blank sheet provided if space not sufficient)

1. Discharge measurement

Area of measuring tank, A= L x B =_____ m^2

Time of collection of liquid = T =_____ sec

H= Rise in liquid level collected in measuring tank in T sec =_____

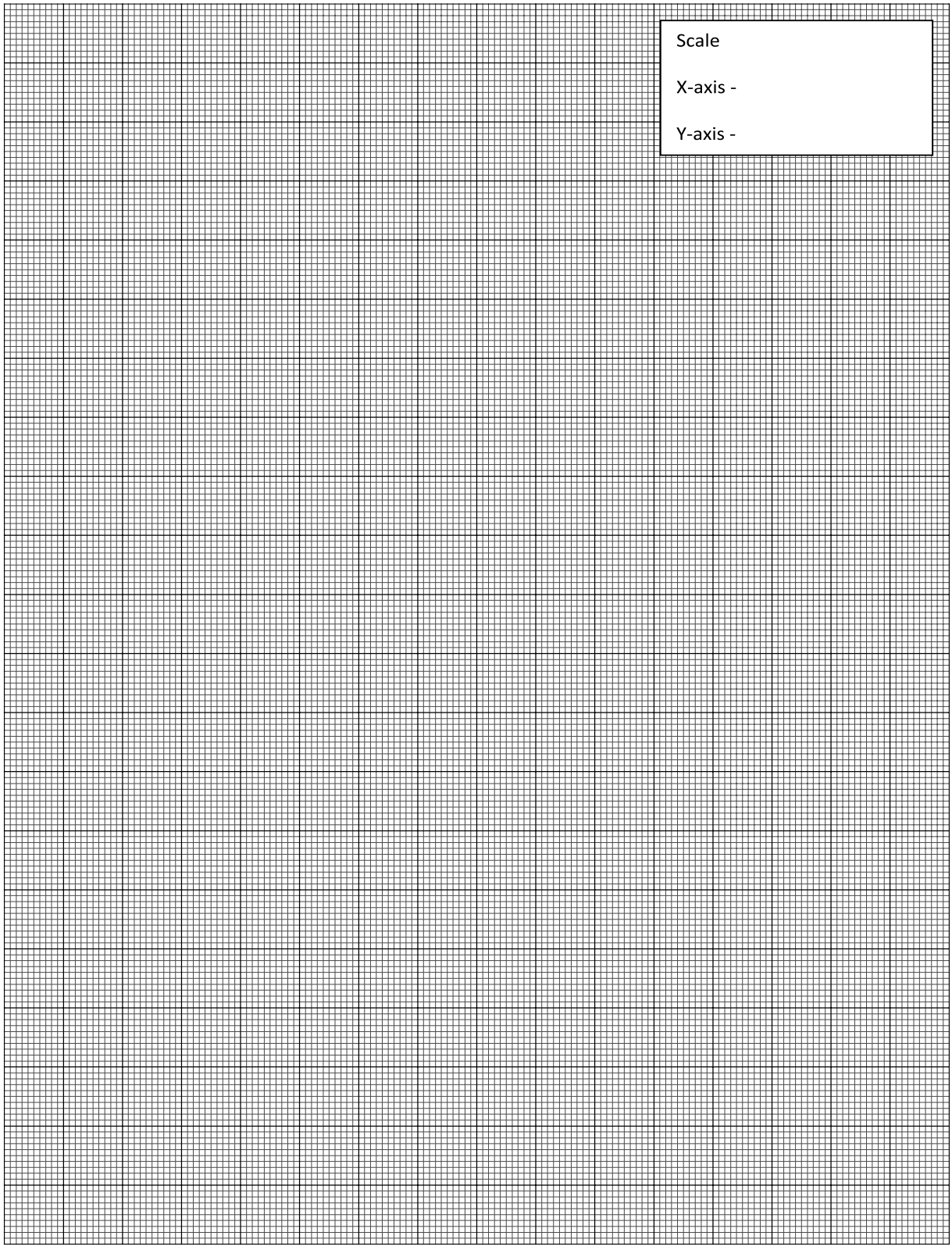
Table for measuring discharge

Run no.	Initial level of water in measuring tank H_1	Final level of water in measuring tank H_2	Rise in level of water in measuring tank $H=H_2-H_1$	Time T	Volume of water Ax H	Discharge Q=Volume/time
Units	In meter	In meter	In meter	sec	m^3	m^3/sec
1						
2						
3						

Table for calculation of total head/ Energy

Piezometer number		1	2	3	4	5	6	7	8	9	10	11
C/S area of pipe												
	Pr Head= p/ γ											
	Velocity, V= Q/A											
	Vel. head = $V^2/2g$											
	Datum head = Z											
	Total head=											

Run no 1	$p/\gamma + V^2/2g+Z$											
Run no 2	Pr Head= p/γ											
	Velocity, V=Q/A											
	Vel. head= $V^2/2g$											
	Datum head= Z											
	Total head= $p/\gamma + V^2/2g+Z$											
Run No 3	Pr Head= p/γ											
	Velocity, V=Q/A											
	Vel head= $V^2/2g$											
	Datum head= Z											
	Total head= $p/\gamma + V^2/2g+Z$											


Scale
X-axis -
Y-axis -

XVI. Results

Total head= $p/\gamma + V^2/2g+Z$

1. _____ m
2. _____ m
3. _____ m

XVII. Interpretation of results (Give meaning of the above obtained results)

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XVIII. Conclusions and Recommendations (if any)

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XIX. Practical Related Questions

Note: *Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. Write Bernoulli's formula and give meaning of each term.
2. State the limitations of the Bernoulli's theorem.
3. State the practical applications of the Bernoulli's theorem.
4. State modified Bernoulli's theorem.
5. Draw the graph of pressure energy, kinetic energy and total energy for the observations taken.

[Space to Write Answers]

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan, R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links :

1. https://www.youtube.com/watch?v=hYBCaRdEvjU
2. https://www.youtube.com/watch?v=ev-3wrE8WWQ
3. https://www.youtube.com/watch?v=wR0AlZddJtY

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related: 15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related: 10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total : 25 Marks		**100%**

List of Student Team Members

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Marks Obtained			Dated Signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 09: Determine Friction Factor for the Given Pipe.

I. Practical Significance

When water is flowing in a pipe, it experiences resistance to its motion whose effect is to reduce the velocity and finally reduces the discharge. It depends upon the roughness of the inside wall of the pipe. This resistance is known as frictional resistance and loss occurred is known as head loss due to friction. Head loss due to friction is to be found out and it is an important parameter in the design of pipe lines.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Determine the loss of head of fluid flow through pipes.

IV. Practical Outcome

Use the Friction factor Apparatus to determine friction factor for the given pipe.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Determine friction factor for a given pipe.
b. Apply Darcy's Weisbach equation to find Head loss due to friction.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background:

Total energy of fluid flow reduces in the direction of flow. The loss in energy is mainly (major reason of loss) due to friction and some minor losses.

Darcy's Weisbach Equationis used to find the Friction loss in flow through pipes,

$$h_f = f\,lv^2/2gD = \frac{flQ^2}{12.1D^5}$$

Where, f = Darcy's friction factor
l = length of the pipe,
V = velocity of flow,
D = Diameter of the pipe,
Q = Discharge,
g = acceleration due to gravity

VIII. Experimental Set-up

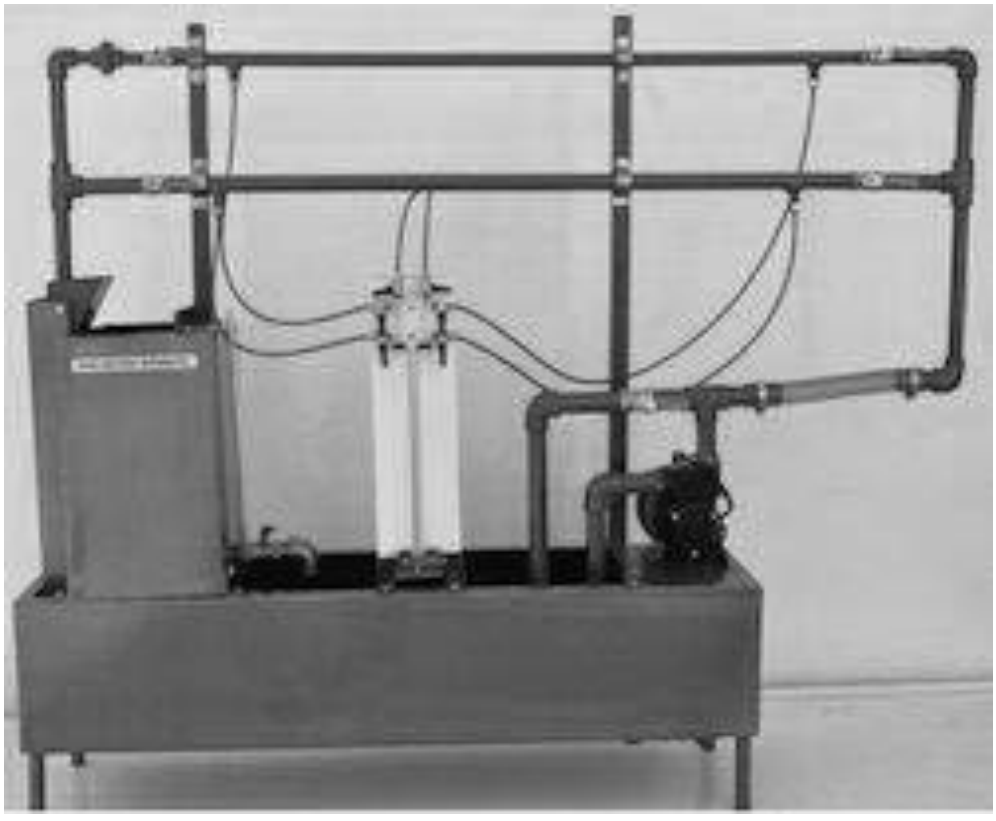

Figure 1. Pipe friction factor apparatus

IX. Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Pipe friction factor apparatus	Standard make	1	For each batch

X. Procedure

1. Open the inlet valve and allow the flow to pass through the desired pipe.
2. From overhead tank allow water to flow through desired pipe for 2-3 minutes.
3. Open tapping of manometer on desired pipe.
4. Measure the rise in the level of water in the measuring tank for predetermined time interval and calculate the discharge.
5. Measure the height of mercury column in left as well as right limb of U tube differential manometer. The respective level of mercury in each limb is to be noted in the observation table.
6. Repeat procedure for 3-4 different discharge conditions by operating the inlet valve.
7. Repeat the steps 2-6 for pipes of different diameter by allowing the water to flow through the required pipe line by opening the respective valves.

XI. Precautions to be followed

1. Use the apparatus carefully.
2. Observe the readings with precision.

XII. Actual procedure followed (To be written by students)

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
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XIV. Precautions followed

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XV. Observations and Calculations (Use blank sheet provided if space not sufficient)

1. Material of pipe =_____
2. Area of Measuring tank = L x B =_____ m.
3. Distance between pressure tappings, l =_____ m^2
4. Specific gravity of fluid in pipe S_1 =_____
5. Specific gravity of fluid in manometer S_2 =_____

Sr. No.	Dia Of Pipe, D	Manometer reading			$h_f = x(S_2/S_1-1)$	Rise of water in measuring tank in m, H	Time for collecting water in measuring tank, T sec	Q = LBH/T	Darcy's friction factor, $f=\frac{12.1 h_f D^5}{l Q^2}$
		x_1	x_2	$x = x_1-x_2$					
1									
2									
3									

Sample Calculations

$h_f = x(S_2/S_1-1)$

Darcy's factor, $f = \frac{12.1 h_f D^5}{l Q^2}$

XVI. Results:

Darcy's friction factor, f =

i. _____

ii. _____

iii. _____

XVII. Interpretation of results (Give meaning of the above obtained results)

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XVIII. Conclusions and Recommendations (if any)

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XIX. Practical Related Questions

Note: *Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the total volume of the tank used for collecting water.
2. State the power of the pump used in the hydraulic bench.
3. State the type of material the pipes are made of.
4. State the capacity of the Sump tank.

[Space to Write Answers]

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan, R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links:

a. https://www.youtube.com/watch?v=w7n0srAzm8g
b. https://www.youtube.com/watch?v=yo0ZBnn12dU
c. https://www.youtube.com/watch?v=Bfg7U5hTPVo

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the Test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answers to practical related questions	10%
6	Submission of report in time	10%
Total: 25 Marks		**100%**

List of Student Team Members

1……..

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3……

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Marks Obtained			Dated Signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 10: Minor Losses in Pipe Fittings

I. Practical Significance

When fluid flows through pipe, energy losses occur due to various reasons, in the direction of flow. Predominant loss is due to the friction (pipe roughness). The additional components like inlet, outlet, bend, valves, sudden enlargement and contraction add to the overall head loss of the system resulting in decrease in discharge. While designing pipe line total head loss is required, to be calculated.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Determine the loss of head of fluid flow through pipes

IV. Practical Outcome

Determine the minor losses in pipe fittings due to sudden contraction and sudden enlargement.

V. Competency and Practical Skills

This practical is to develop the following skills for the industry identified compete '**Apply hydraulics principles in water carriage systems and water retaining structures'**

a. Determine the minor losses in pipe fittings.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

When Energy is measured in "meters" is called head. The minor head losses are caused by certain local features or disturbances. The disturbances may be caused in the size or shape of the pipe. This deformation affects the velocity distribution and may result in eddy formation.

Sudden Enlargement:- Two pipes of cross-sectional area A_1 and A_2 are as shown in figure 1. When the enters the larger section eddies will form resulting in turbulences and causing dissipation of energy.

The loss in head or energy due to sudden enlargement is given by:-

$$\mathbf{h}_{\text{enlargement}} = (V_1\text{-}V_2)^2/2g$$

Sudden Contraction:- It represents a pipe line in which an abrupt contraction occurs. The area of flow minimizes a little distance away from actual area of contraction of pipe is known as vena contracta, refer figure 2

$$h_{con} = \frac{0.5\,v^2}{2g} \qquad h_{con} = \left(\frac{1}{C_c} - 1\right)^2 \frac{v^2}{2g}$$

VIII. Experimental Set-up

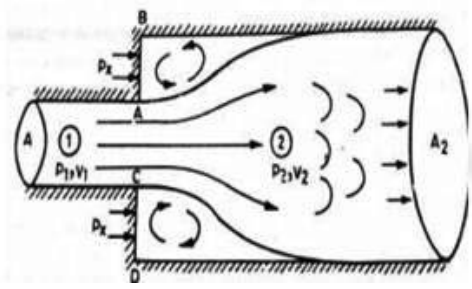

Figure 1.Sudden enlargement

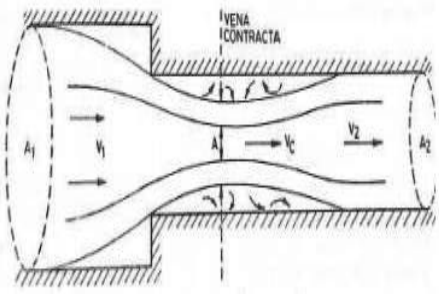

Figure 2.Sudden contraction

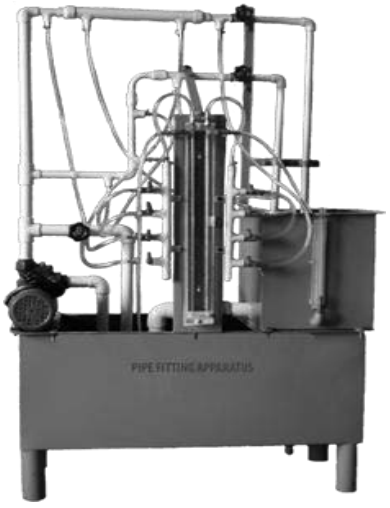

Figure 3. Experimental set up

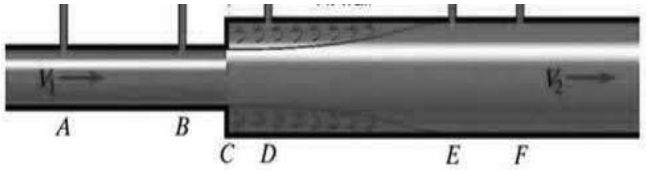

Figure 4. Sudden enlargement

IX. Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	Pipe of known diameter fitted with sudden enlargement, sudden contraction.	Standard make	1	For each batch
2	Discharge measuring tank fitted with a scale and piezometer tube	Standard make	1	For each batch
3	U tube differential manometer	Standard make	1	For each batch

X. Procedure

1. Open the inlet valve, keeping the outlet valve closed.
2. Connect the manometer rubber tubing to one of the pipes/pipe fitting and check that there is no air bubble entrapped.
3. Open partially the outlet valve, keeping the common inlet valve fully open.
4. Allow the flow to get stabilized and then take manometer reading.
5. Measure discharge.
6. Repeat the procedure at least three times.

XI. Precautions to be followed

a. Avoid spilling of water while conducting this experiment.
b. Maintain the adequate pressure by adjusting valve.
c. Take the readings accurately.
d. Handle mercury with care.
e. No air should be entrapped in the apparatus system.

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
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XIV. Precautions followed

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XV. Observations

Area of Measuring Tank = _____ m^2

Area of large pipe (A_1) = _____ m^2

Area of small pipe (A_2) = _____ m^2

Pipe fitting	**Manometer Reading (for mercury manometer)***				**Discharge measurement**					**Head loss obtain by discharge (calculations)**	**Head loss obtained by manometer reading (observations Hm)**
Sudden enlarge-ment	h_1	h_2	h = (h_1- h_2)	H = $h(\frac{S_2}{S_1}-1)$	Volume = area of measuring tank x rise in water level in measuring tank	Time	Q= Volume /time	**V_1= Q/A_1**	**V_2 = Q/A_2**	**h = $\frac{(V_1-V_2)^2}{2g}$**	
1											
2											
3											
Sudden contract-ion										**h_c = (0.5$v_2^{2/}$/ 2g)**	
1											
2											
3											

*If manometric liquid is water then use h=H

Sample calulations

For sudden enlargement= $h_{enlargement} = (v_1-v_2)^2/2g$

For sudden contraction= $h_{con} = (0.5v_2^{2/}/2g)$

XVI. Results

Average value of head loss in

Sudden enlargement = _____ m.

Sudden contraction = _____ m.

XVII. Interpretation of results

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XVIII. Conclusions and Recommendations (if any)

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XIX. Practical Related Questions

***Note**: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. Write the formula for head loss due to sudden enlargement , sudden contraction , and write meaning of each term.
2. Mention the measures taken to reduce minor losses in house plumbing.
3. Describe the variation of minor losses when discharge is increased or decreased by operating regulating valve.

Space to Write Answers

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan, R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links:

1. *https://www.youtube.com/watch?v=6jClbqlGctY*
2. https://www.youtube.com/watch?v=RCKfQgnp5sU

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the test/ Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total: 25 Marks		**100%**

List of Student Team Members

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4……

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 11: Minor Losses in Pipe Fittings

I. Practical Significance

When fluid flow through pipe, energy losses occur due to various reasons, in the direction of flow. Predominant loss is due to the friction (pipe roughness). The additional components like inlet, outlet, bend, valves, sudden enlargement and contraction add to the overall head loss of the system resulting in decrease in discharge. While designing pipe line total head loss is required, to be calculated.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

IV. Relevant Course Outcomes

Determine the loss of head of fluid flow through pipes

V. Practical Outcome

Determine the minor losses in pipe fittings due to sudden contraction and sudden enlargement.

VI. Competency and Practical Skills

This practical is to develop the following skills for the industry identified competency'**Apply hydraulics principles in water carriage systems and water retaining structures'**

a. Determine the minor losses in pipe fittings.

VII. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VIII. Minimum Theoretical Background

Minor loss in a bend is due to flow separation on the curved walls and a swirling secondary flow arising from the centripetal acceleration. Since the flow pattern in valves, bends and fittings are quite complex, The losses are usually measured experimentally and correlated with the pipe flow parameters. In turbulent flow, the Minor Loss varies as the square of the velocity.

$$hm = k\, v^2/2g$$

Where, hm = minor loss for a fitting, while calculating head loss due to bend k = coefficient of bend which dependence upon angle of bend, radius of curvature of bend and diameter of pipe, while calculating head loss due to fitting (elbow) k= coefficient which depends upon the type of the pipe fitting .v = mean velocity of the flow in the pipe. Bends are provided in pipes to change the direction of flow through it.

IX. Experimental Set-up

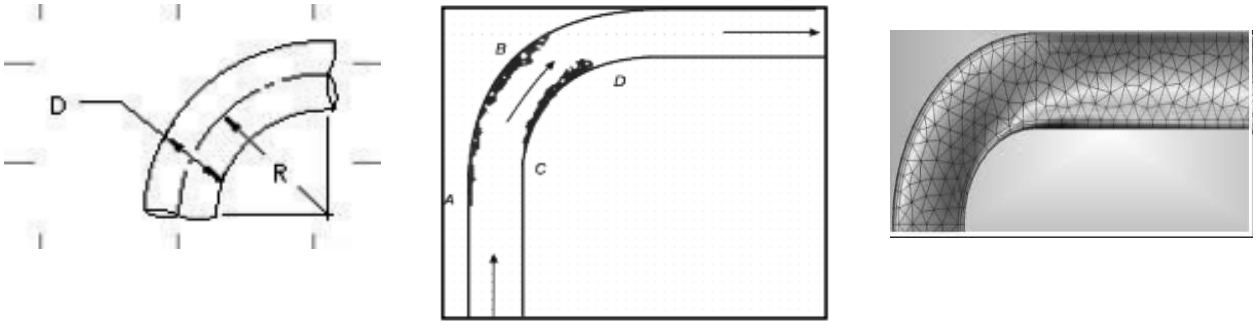

Figure 1.Bend

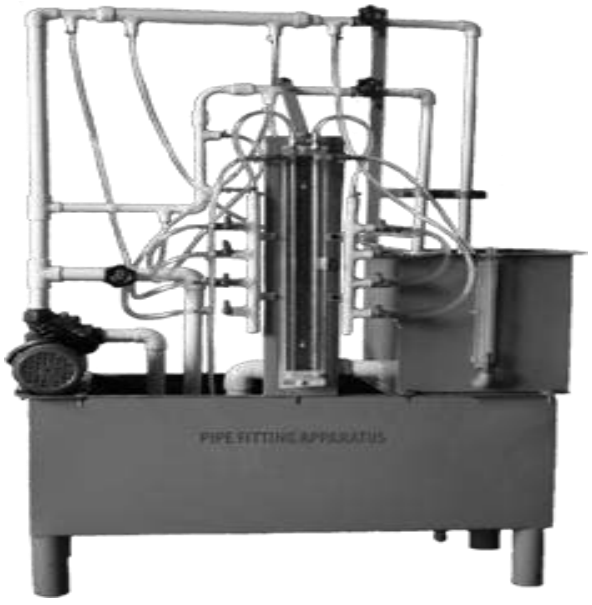

Figure 2. Experimental set up

X. Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	Pipe of known diameter fitted with bent and elbow	Standard make	1	For each batch
2	Discharge measuring tank fitted with a scale and piezometer tube	Standard make	1	For each batch
3	U tube differential manometer	Standard make	1	For each batch

XI. Procedure

1. Open the inlet valve,keeping the outlet valve closed.
2. Connect the manometer rubber tubing to one of the pipes/pipe fitting and check that there is no air bubble entrapped.
3. Open partially the outlet valve, keeping the common inlet valve fully open.
4. Allow the flow to get stabilized and then take manometer reading.
5. Measure discharge
6. Repeat the procedure at least three times

XII. Precautions to be followed

a. Avoid spilling water while conducting this experiment.
b. Maintain the adequate pressure by adjusting valve.
c. Take the readings accurately.
d. Handle mercury with care.
e. No air should be entrapped in the apparatus system.

XIII. Actual procedure followed

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XIV. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					
4					

XV. Precautions followed

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XVI. Observations

Area of Measuring Tank = _____ m^2

Area of large pipe (A_1) = _____ m^2

Area of small pipe (A_2) = _____ m^2

Pipe fitting	Manometer Reading (for mercury manometer)*				Discharge measurement					Head loss obtain by discharge (calculations)	Head loss obtained by manometer reading (observations
Pipe bend	h_1	h_2	h = (h_1-h_2)	H= $h(\frac{S_2}{S_1}-1)$	Volume =area of measuring tank x rise in water level in measuring tank	Time	Q = Volume/time	V_1=Q/A_1	V_2= Q/A_2	h_{bend}= ($Kv^{2/}$ /2g)	
1											
2											
3											

Pipe fitting (elbow)										$H_{pipe\ fitting} = (Kv_2^{2/}/2g)$	
1											
2											
3											

*If manometric liquid is water then use h=H

Sample Calculations

For bend= h bend = $(KV)^2/2g$

For sudden elbow= h elbow= $(Kv^{2/}/2g)$

XVII. Results

Average value of head loss in = _____

Due to bend = _____m.

Due to elbow = _____m.

XVIII. Interpretation of results

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XIX. Conclusions and Recommendations (if any)

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XX. Practical Related Questions

***Note**: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1 Write the formula for head loss due to bend , elbow, and write meaning of each term.

2 Mention the measures taken to reduce minor losses in house plumbing.

3 Describe the variation of minor losses when discharge is increased or decreased by operating regulating valve.

Space to Write Answers

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XXI. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
3	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
4	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan, R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested link

1. *https://www.youtube.com/watch?v=6jClbqlGctY*
2. https://www.youtube.com/watch?v=FW1se5jW8X0

XXII. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related: 15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related: 10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total : 25 Marks		**100%**

List of Student Team Members

1…….

2……..

3……..

4…….

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 12: Venturimeter

I. Practical Significance

A Venturimeter is a device used to measure the rate of flow that is discharge of a fluid in a pipe. A Venturi meter may also be used to increase the velocity of any type of fluid in a pipe at any particular point. This device is permanently fixed in a pipe line. The calibrated Venturimeter can be used to measure discharge, wherever required.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO ***5. Individual and Team Work:*** *Function effectively as leader and team member in Diverse /multidisciplinary team.*

III. Relevant Course Outcomes

Determine the loss of head of fluid flow through pipes.

IV. Practical Outcome

Calibrate the Venturimeter to find out the discharge in a pipe.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

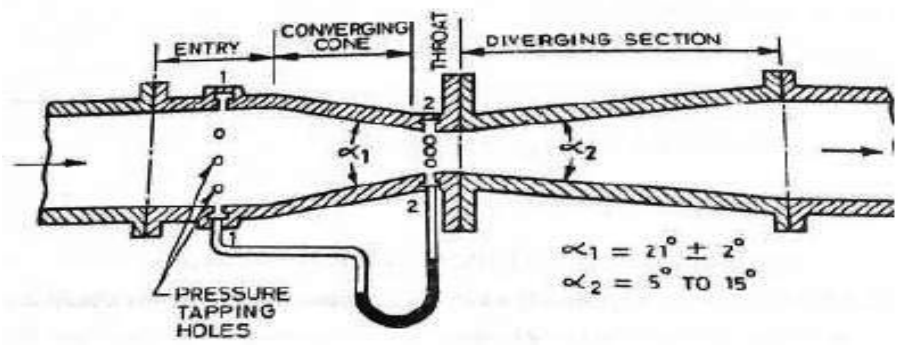
a. Measurement skill.
b. Identify components of venturimeter apparatus.
c. Demonstrate purpose /function of each component.
d. Determine the coefficient of discharge for venturimeter.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

Venturi meter is the practical application of Bernoulli's theorem. When a venturimeter is placed in a pipe carrying the fluid whose flow rate is to be measured, a pressure drop occurs from the convergent cone to the throat of the venturimeter.



Coefficient of discharge is the ratio of actual discharge to the theoretical discharge. Actual discharge is always less than theoretical discharge because of major and minor losses.

$$C_d = \frac{Q_{Actual}}{Q_{Theorotical}}$$

VIII. Experimental Set-up

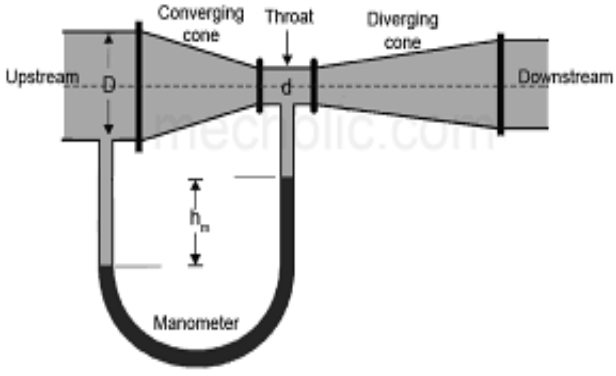


Figure 1. Venturimeter

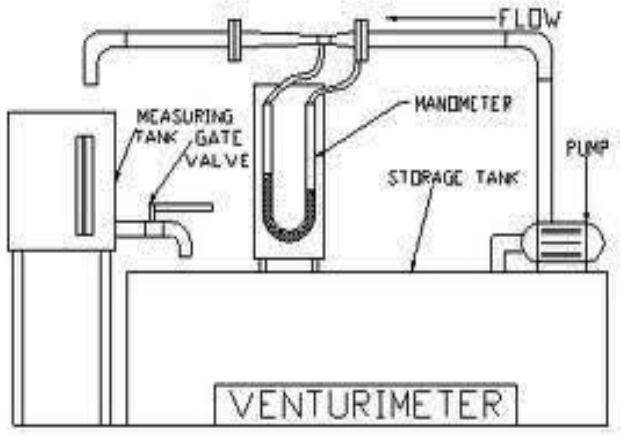


Figure 2. Venturimeter

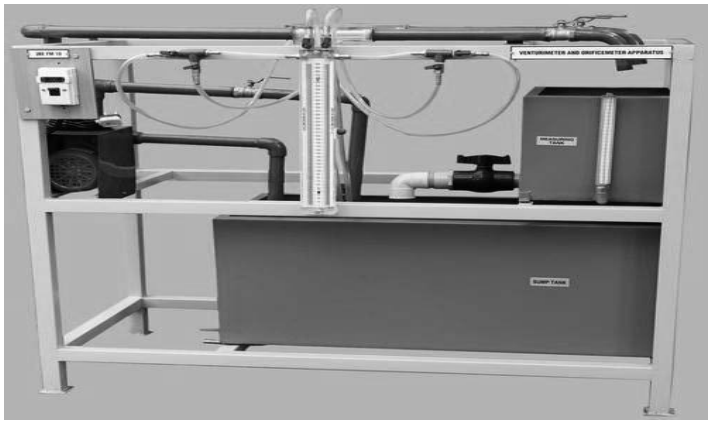


Figure 3. Experiment set up

IX. Resources required

Sr. No.	Particulars	Specification	Quantity	Remark (Photos)
1	Venturimeter fitted on pipeline	Standard make	1	For each batch
2	Discharge measuring tank fitted with a scale and piezometer tube	Standard make	1	For each batch
3	U- tube differential manometer	Standard make	1	For each batch

X. Procedure:

1. Open the inlet regulating valve so that water starts flowing through the venturimeter.
2. Wait for some time so that flow gets steady.
3. Remove air bubbles if any entrapped, in piezometric tubes or U-tube differential manometer.
4. Note differential manometric reading h.
5. Measure the discharge by collecting a certain volume of water in measuring tank in predetermined time.
6. Repeat the procedure at least three times.

XI. Precautions to be followed

1. Measure the discharge carefully.
2. Use the apparatus carefully.
3. Observe the readings with precision.
4. Remove air bubble from manometer.
5. Maintain constant discharge before taking reading.

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
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3					
4					

XIV. Precautions followed

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XV. Observations

Area of Measuring Tank = _____ m^2
Diameter of large pipe (D) =_____m
Area of large pipe (A) = π/4 x D^2 = _____ m^2
Diameter of small pipe (d) = _____m
Area of large pipe (A) = π /4 x d^2= _____ m^2

Sr. No.	Rise of water level in measuring tank (H) m	Volume of water collected V=A * H	Time T sec	Discharge Q_{actual} = Volume/T m^3/s	Difference of manometric liquid between two limbs		Therotical discharge by formula = Q_{th}	Coefficent of discharge $C_d=Q_{act}/Q_{th}$	Average C_d
					Diff h_m (m)	Δh= $h_m*(S_2/S_1-1)$			
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3									
4									

Sample calculations

$$Q_{act} = \frac{Vol.of\ water\ collected\ in\ the\ tank}{Time}$$

$$Q_{th} = \frac{Aa}{\sqrt{A^2 - a^2}}\sqrt{2g\Delta h}$$

$$C_d = \frac{Q_{\ Actual}}{Q_{Theorotical}}$$

XVI. Results

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XVII. Interpretation of results

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XVIII. Conclusions and Recommendations (if any)

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XIX. Practical Related Questions

Note*: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. Name or Identify the parts of venturimeter where maximum velocity of flow will occur.
2. Pressure at the throat of venturimeter is minimum. Give reason.
3. In venturimeter, length of divergent cone is always greater than convergent cone. Give reason.
4. Is it possible to use venturimeter for measuring discharge in an open channel.
5. Define coefficient of discharge? State the unit.
6. State the use of measuring tank?
7. State the sequential steps to calculate the actual discharge.

8. Therotical discharge is always greater than actual discharge. Give reason.
9. Give the practical situations where the concept/ Principle of venturimeter is used.

Space to Write Answers

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi **ISBN:**13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, andNarayan, R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841
3	Fluid Mechanics	Rajput, R K	S Chand, New Delhi ISBN: 9788121916677

Suggested link:-

1. https://www.youtube.com/watch?v=UNBWI6MV_lY
2. https://www.youtube.com/watch?v=W2W0n-9mHXw
3.

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total: 25 Marks		**100%**

List of Student Team Members

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2……..

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Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 13: Coefficients of Circular Orifice

I. Practical Significance

An orifice is an opening in the wall or base of a vessel through which fluid flows. The top edge of orifice is always below the free liquid surface. The water is allowed to flow through an orifice under a constant head 'H'. Fluid is discharged in the form of a jet of flow.

II. Relevant Program Outcomes (POs) *Basic knowledge:*

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. Discipline knowledge: An ability to apply discipline - specific knowledge to solve *core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team.*

III. Relevant Course Outcomes

Find the fluid flow parameters in open channels.

IV. Practical Outcome

Calibrate the Orifice to find out the discharge through a tank.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Understand concept of hydraulic coefficient (C_c, C_d, C_v).
b. Measurement of horizontal and vertical co-ordinates of jet.
c. Measurement of diameter of vena contracta.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

Orifice is an opening of any cross section such as circular, triangular, rectangular, on a side or on the bottom of the tank, through which a fluid flows. Orifices are used for measuring the rate of flow. It may be observed that liquid approaching the orifice is gradually converges towards orifice, to form a jet whose c/s area is less than that of the orifice, known as vena contracta.

The discharge will depend up on the head of the fluid (H) above the level of the orifice.

VIII Experimental Set-up

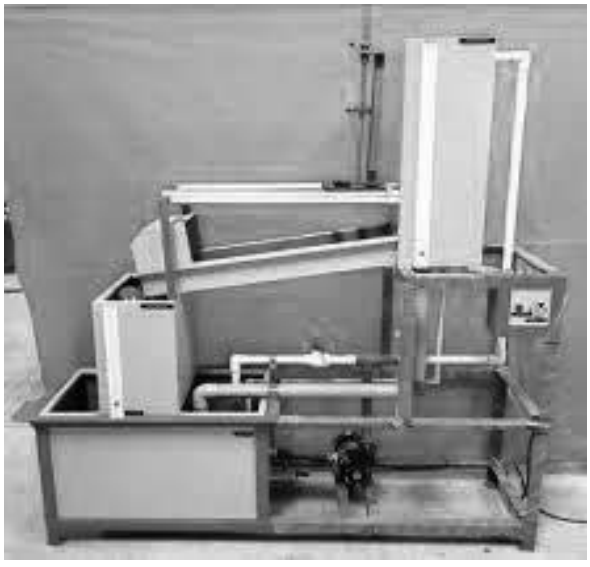

Figure 1.Orifice Experimental Set Up

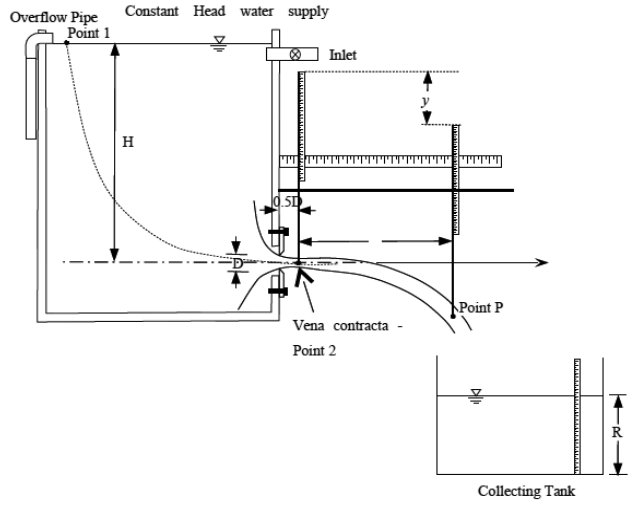

Figure2.Orifice Experimental Set Up

VIII. Resources required

Sr. No.	Particulars	Specification	Quantity	Remark
1	Supply tank with piezometer	Standard make	1	For each batch
2	Discharge measuring tank fitted with a scale and piezometer tube	Standard make	1	For each batch
3	Vernier Caliper	Standard make	1	For each batch
4	Stop watch	Standard make	1	For each batch

IX. Procedure

1. Connect the desired size and shape of orifice to the opening in the sidewall of the intake tank.
2. Allow water to intake tank through the regulating valve and wait till the water level in the tank becomes steady.
3. Measure the head using the piezometric tube fixed to the intake tank.
4. Measure the discharge corresponding to each value of H.
5. Take minimum three readings.
6. Measure X and Y coordinates of the lower surface of the jet trajectory at four different points (origin to be taken at lowest point of the jet at vena contracta).

X. Precautions to be followed

1. Avoid spilling water while conducting this experiment.
2. Maintain the adequate head in intake tank.
3. Take the readings accurately.

XII Actual procedure followed

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XI. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
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XII. Precautions followed

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XIII. Observations

a. Shape of orifice =_____
b. Diameter of orifice =_____m
c. Cross sectional area of orifice (a) = _____m^2
d. Cross sectional area of measuring tank (A) =_____m^2
e. ΔH = rise in water level in measuring tank = _____ m.

Sr. No.	ΔH	t	$Q_{ac} = \frac{A \times \Delta H}{t}$ cm^3/s	Constant head at inlet H Cm	$Q_{ac} = a \times \sqrt{2gH}$	X cm	Y cm	$C_d = \frac{Q_{ac}}{Q_{th}}$	Mean C_d
1									
2									
3									
4									

Sr. No.	$C_v = \sqrt{\frac{X^2}{4yH}}$	Mean C_v	$C_c = \frac{C_d}{C_v}$	Mean C_c
1				
2				
3				
4				

Sample Calculations

$$C_d = \frac{Q_{actual}}{a\sqrt{2gH}}$$

$$C_v = \sqrt{\frac{X^2}{4yH}}$$

$C_c = C_d / C_v$

XIV. Results

The hydraulic coefficients of orifice

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XV. Interpretation of results

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XVI. Conclusions and Recommendations

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XVII. Practical Related Questions

***Note**: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1 State the formula for determination of theoretical discharge, and write meaning of each **term.**
2 Define coefficient of discharge,coefficient of velocity,contraction.state relation between them.
3 State the stepwise procedure to measure the actual discharge.
4 Constant head is to be maintained in the tank, while taking the reading. Give reason.

Space to Write Answers

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XVIII. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi **ISBN:**13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan,R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links:

1. https://www.youtube.com/watch?v=A0BuHEqDm88
2. https://www.youtube.com/watch?v=ukLQw9bGac4
3. https://www.youtube.com/watch?v=_sG967TTAoE

XIX Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total: 25 Marks		**100%**

List of Student Team Members

1……..

2……..

3……..

4……..

Marks Obtained			Dated Signature of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 14: Current Meter

I. Practical Significance

Current Meter is used for measuring the velocity of water in open channel. It is miniatures section of turbine streams, open canals, pressure pipes, lakes and seas. This practical is enabling to calculate velocity using current meter.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Find the fluid flow parameters in open channels.

IV. Practical Outcome

Use the current meter to measure the velocity of flow of water in open channel.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Understand component parts of current meter.
b. Understand the calibrated chart provided by manufacturer.
c. Measurement of velocity by current meter.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

Current meter is an instrument used to measure velocity of flow of water in open channel It consists of a wheel or revolving element containing blades or cups , and a tail on which flat veins or fins are fixed.

Current meters are of two types-

i. Propeller-type current meter

ii. Cup type current meter

The working principle of current meters is, when immersed in the flowing water, which causes the blades/cups of the current meter to rotate. In cup type current meter the wheel or the revolving element has the form of series of conical cups mounted on a spindle which is held vertical at right angle to the direction of flow.

VIII. Experimental Set-up

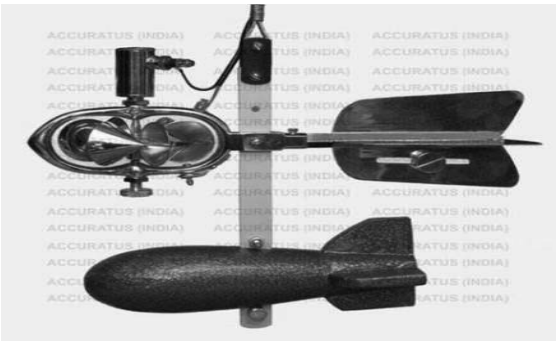

Figure 1. Current meter

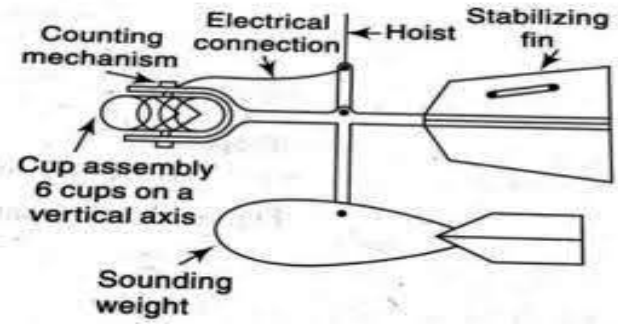

Figure 2. Line sketch of current meter

IX. Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Current meter	Standard make	1	For each batch

X. Procedure

1. Assemble the current meter (propeller or cup type) available in hydraulics lab.
2. The current meter is lowered to desired depth in a channel or cannal at which velocity of flow is to be calculated.
3. Ensure that the cups /propeller side is in the upstream side of flow.
4. When the cup start rotating switch on the revolution counter.
5. Find the number of revolutions for known time and record it.

XI. Precautions to be followed

1. Current meter should placed along the direction of flow.
2. Take the readings accurately.

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					
4					

XIV. Precautions followed

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XV. Observations

Velocity of flow corresponding to N_1 revolution of current meter made in t seconds = V_1

Velocity of flow corresponding to N_2 revolution of current meter made in t seconds = V_2

The values of N_1, N_2, V_1, V_2 corresponding to time t seconds , are read from rating table of the current meter , so that velocity of flow , v, corresponding to time t seconds , are read from the rating table of the current meter , so that velocity of flow , v , corresponding to N revolutions of current meter made in t seconds could be calculated as shown below

Sr. No.	Time (t)	No. of revolution recorded (N)				$v = v_1 + \left(\frac{v_2 - v_1}{N_2 - N_1}\right)(N_2 - N_1)$
		N_1	V_1	N_2	V_2	
1						
2						
3						
4						
5						

Sample calculations

Time of recording (t) = _____sec.

Number of revolution = _____

From rating table for above value of t and N

N_1=_____ V_1=_____m/s

N_2=_____ V_2=_____m/s

$V= v_1+ (v_2-v_1/n_2-n_1)(N_2-N_1)$

XVI. Results

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XVII. Interpretation of results

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XVIII. Conclusions and Recommendations

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XIX. Practical Related Questions

***Note**: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. Write the uses of current meter.
2. Give function of counter weight.
3. Draw the neat sketch of cup type current meter.
4. How will you measure discharge using current meter

Space to Write Answers

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi **ISBN:**13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan,R.	DhanpatRai Publishing Company, Nev Delhi, **ISBN:**8187433841

Suggested links

1. https://www.youtube.com/watch?v=dgfqoVqbHw0
2. https://www.youtube.com/watch?v=sJ7oT7RTpew

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total: 25 Marks		**100%**

List of Student Team Members

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Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 15: Pitot Tube.

I. Practical Significance

A Pitot tube is an instrument used to measure velocity of a flow. The Pitot tube is used to measure the local velocity at a given point in the flow.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Find the fluid flow parameters in open channels.

IV. Practical Outcome

Use the Pitot tube to measure the velocity of flow of water in open channel.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency **'Apply hydraulics principles in water carriage systems and water retaining structures.'**

a. Understand component parts of pitot tube.
b. Measurement of velocity by pitot tube .

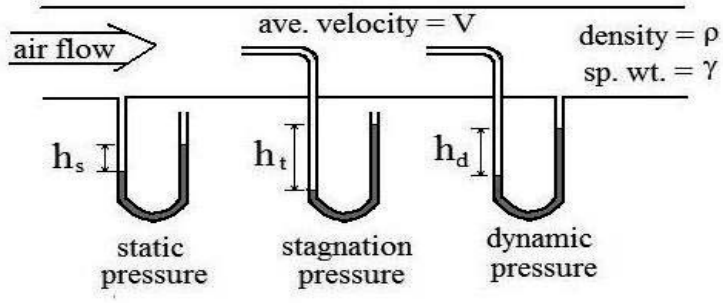
VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

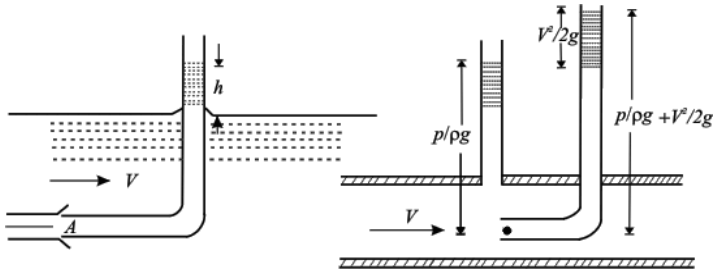
VII. Minimum Theoretical Background

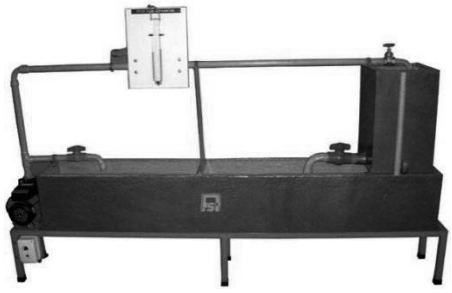
Pitot tube is a device used to measure the velocity of a flow . It is the practical application of Bernoulli's theorem. It is placed in the flow with its bent leg directed upstream so that stagnation point is created immediately in front of opening. The kinetic energy at this point gets converted into pressure energy causing the liquid to rise in the vertical limb to a height equal to stagnation pressure.

$V_{th} = \sqrt{2gh}$ where h is the height of water raised in pitot tube.



VIII. Experimental Set-up





IX. Resources required

Sr. No	Particulars	Specification	Quantity	Remark
1	Pitot tube	Standard make	1	For each batch

X. Procedure

1. Insert the pitot tube with its nose in upstream direction in the flow at desired depth.
2. Connect the inner and outer tubes of two limbs of differential manometer.
3. The pressure tappings are opened and allowed the flucating mercury surface to become steady.
4. Record the mercury level in the both the tubes. Repeat it for same depth for three times at upstream and down stream.
5. Repeat the experiment for different value of depth like 0.2d, 0.4d etc.

XI. Precautions to be followed

1. Measure the discharge carefully.
2. Use the apparatus carefully.
3. Observe the readings with precision.
4. Pitot tube should be placed with its nose in upstream direction.
5. Take the readings accurately.

XII. Actual procedure followed (To be written by students)

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
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XIV. Precautions followed

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XV. Observations

Table 1.Table for calculating velocity

Run No.	Depth (d)	Manometer Reading			Velocity $v = \sqrt{2gh}$	Remark
		h_1	h_2	$h = h_2 - h_1$		
1	0.2d					
2						
3						
4	0.4d					
5						

Sample Calculation

$$v = \sqrt{2gh}$$

XVI. Results

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XVII. Interpretation of results

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XVIII. Conclusions and Recommendations

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XIX. Practical Related Questions

Note*: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the use of pitot tube.

2. Define static pressure.
3. Define stagnation pressure.
4. Define dynamic pressure.
5. We can't use pitot tube to measure velocity of flow in a pipe? Give reason.

Space to Write Answers

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan,R.	DhanpatRai Publishing Company, Nev Delhi, **ISBN:**8187433841

Suggested link

1. https://www.youtube.com/watch?v=uUfe0QJMfcM
2. https://www.youtube.com/watch?v=JhxuFEauU9A

XXI. Suggested assessment scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the test / Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total: 25 Marks		**100%**

List of Student Team Members

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Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 16: Triangular Notch

I. Practical Significance

Notch is used to measure rate of flow in an open channel. Notch may be defined as opening provided in the side of tank or vessel such that the liquid surface in the tank is below the top edge of the opening. A notch may be regarded as an orifice with the water surface below its upper edge. It is used for measuring the rate of flow of a liquid through a small channel or a tank.

The main difference between a notch and weir is that the notch is of small size but the weir is of bigger one. Moreover a notch is usually made in a plate whereas a weir is usually made of masonry or concrete.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Find the fluid flow parameters in open channels.

IV. Practical Outcome

Use the Triangular notch to measure the discharge through open channel.

V. Competency and Practical Skills

This practical is to develop the following skills for the industry identified competency. '**Apply hydraulics principles in water carriage systems and water retaining structures'**

a. Measurement of Head over the notch.
b. Identify components equipment.
c. Demonstrate purpose /function of each component.
d. Determine the coefficient of discharge for triangular notch.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.

d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

A Notch is a device used for measuring the rate of flow of a liquid through a small channel or a tank. It may be defined as an opening in the side of a tank or a small channel in such a way that the free liquid surface is always below sill or edge of an opening. Consider a rectangular notch provided in channel or tank carrying water.

The triangular or V notch is advantageously used to measure (low discharge) the accurate discharge with lower head, over the crest .

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

VIII. Experimental Set-up

Figure 1.Tringular Notch

Figure 2.Tringular Notch

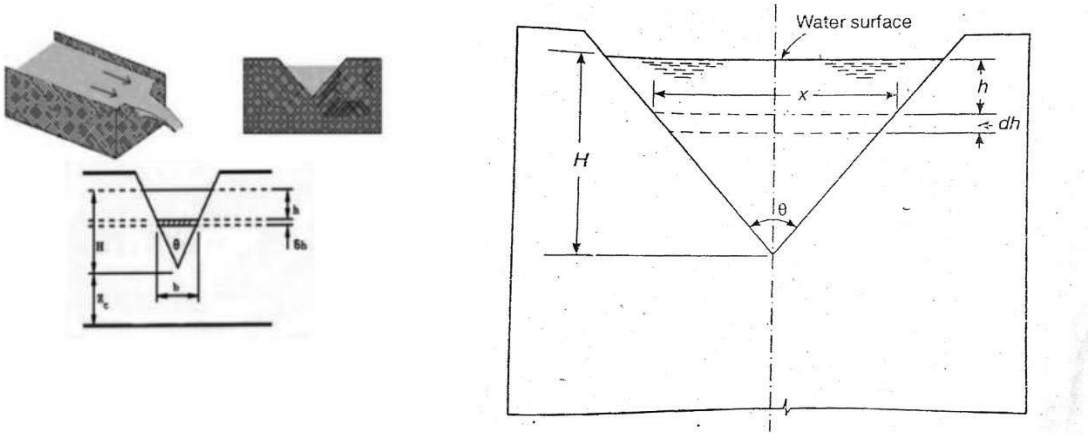

Figure 3.Tringular Notch

IX. Resources required

Sr. No.	Particulars	Specification	Quantity	Remark (Photos)
1	Notch	Standard make	1	One per batch
2	Discharge measuring tank fitted with a scale and piezometer tube	Standard make	1	One per batch
3	Stop watch	Standard make	1	One per batch

X. Procedure

1. Select desired size of triangular notch.
2. Measure angle of triangular notch.
3. Measure the sill level.
4. Record three different readings for three different heads over triangular notch by regulating the flow and measure the actual discharge.

XI. Precautions to be followed

1. Reading must be taken in steady or near steady conditions.
2. Discharge must be varied vary gradually from a higher value to smaller values.
3. Maintain steady and continuous flow over the notch.

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
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2					
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XIV. Precautions followed

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XV. Observations

Sr. No.	Initial Level of water in measuring tank h_1	Final level of water in measuring tank in T sec h = h_1- h_2	Time T sec	Actual Discharge Q_{act} = A x h/ T	Angle of v notch	Headover notch H m	Theorotical Discharge by formula	$C_d = \frac{Q_{Actual}}{Q_{th}}$	Avg C_d
1									
2									
3									

Sample Calculation

Area of measuring tank (A) = _____ m^2 .
Actual Discharge= Q_{act} = A x h/ T = _____m^3/sec.
Theorotical Discharge

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

XVI. Results

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XVII. Interpretation of results

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XVIII. Conclusions and Recommendations

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XIX. Practical Related Questions

Note*: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the formula to calculate discharge over triangular notch. State meaning of each term.
2. State the situations when orifice gets converted into notch.
3. Is the Coefficient of discharge a constant for all notches?
4. State the difference between weir and the notch.

Space to Write Answers

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi **ISBN:**13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan,R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

Suggested links

1. https://www.youtube.com/watch?v=hGLj4FEPmH0
2. https://www.youtube.com/watch?v=MBmuK0tN8oY

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related:15 Marks		**60%**
1	Performing the test/Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related:10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total: 25 Marks		**100%**

List of Student Team Members

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Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 17: Rectangular Notch

I. Practical Significance

Notch is generally used to measure rate of flow in an open channel flow.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO 5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Find the fluid flow parameters in open channels.

IV. Practical Outcome

Use the Triangular notch to measure the discharge through open channel.

V. Competency and Practical Skills

This practical is to develop the following skills for the industry identified competency. '**Apply hydraulics principles in water carriage systems and water retaining structures'**

a. Measurement of Head over the notch.
b. Identify components equipment.
c. Demonstrate purpose /function of each component.
d. Determine the coefficient of discharge for triangular notch.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Practice good housekeeping.
c. Demonstrate working as a leader/ team member.
d. Maintain tools and equipment.
e. Follow ethical Practices.

VII. Minimum Theoretical Background

Rectangular Notch is used to find discharge . Discharge is calculated by formula

$$Q_{th} = \frac{2}{3} \times L\sqrt{2g}\, H^{\frac{3}{2}}$$

VIII. Experimental Set-up

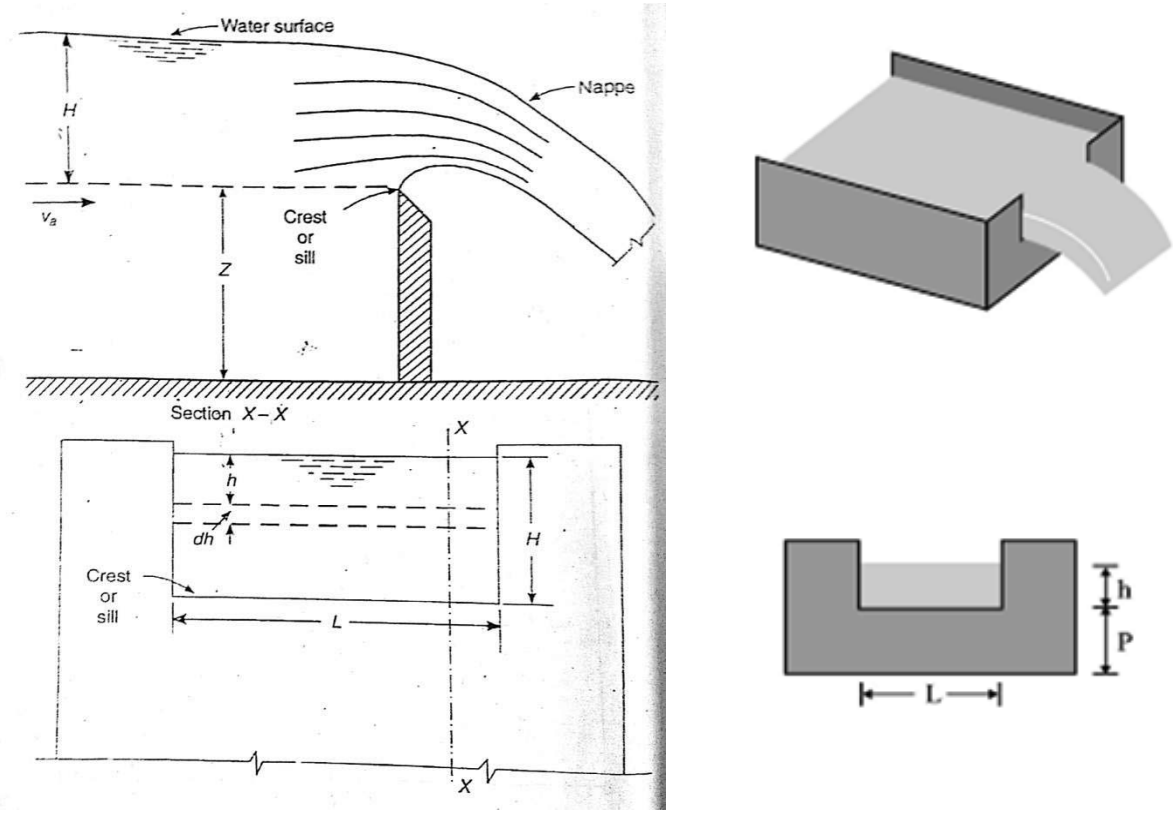

Figure 1. Rectangular notch

IX. Resources required

Sr. No.	Particulars	Specification	Quantity	Remark (Photos)
1	Notch	Standard make	1	Per Batch
2	Discharge measuring tank fitted with a scale and piezometer tube	Standard make	1	Per Batch
3	Stop watch	Standard make	1	Per Batch

X. Procedure

1. Select desired size of rectangular notch.
2. Measure dimensions of rectangular notch.
3. Establish the zero hook gauge reading corresponding to the level of the crest of the notch or take initial reading at crest.
4. Record three readings for head over triangular notch by regulating the flow and measure discharge.

XI. Precautions to be followed

1. Reading must be taken in steady or near steady conditions.
2. For the measurement of correct discharge there must not be anynotch is not running in over flow condition.
3. For measurement of correct head over the notch the point gauge must be installed little distance away from the crest of notch.
4. Discharge must be varied vary gradually from a higher value to smaller values.

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
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XIV. Precautions followed

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XV. Observations

Sr. No.	Initial Level of water in measuring tank h_1	Final level of water in measuring tank in T sec h = $h_1 - h_2$	Time T sec	Actual Discharge Q_{act} = A x h/ T	Length of rectangular notch	Head over notch H m	Theorotical Discharge by formula	$C_d = \frac{Q_{Actual}}{Q_{th}}$	Avg C_d
1									
2									
3									

Sample Calculation

Area of measuring tank (A) = _____ m^2.

Actual Discharge= Q_{act} = A x h/ T = _____ m^3/sec.

Theorotical Discharge $Q_{th} = \frac{2}{3} \times L\sqrt{2g}\, H^{\frac{3}{2}}$

$$C_d = \frac{Q_{Actual}}{Q_{th}}$$

XVI. Results

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XVII. Interpretation of results

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XVIII. Conclusions and Recommendations

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XIX. Practical Related Questions

***Note**: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. State the formula for discharge for rectangular notch. Write meaning of each term.
2. State the advantages of triangular notch over rectangular notch.

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi ***ISBN:***13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan,R.	DhanpatRai Publishing Company, New Delhi, **ISBN:**8187433841

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related: 15 Marks		**60%**
1	Performing the test/ Practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related: 10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total : 25 Marks		**100%**

List of Student Team Members

1……..

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3……

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Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

Practical No. 18: Centrifugal Pump

I. Practical Significance

Centrifugal pumps are used to transport all (viscous) type of fluids. Centrifugal pumps are used to transport fluids by the conversion of rotational kinetic energy to the hydrodynamic energy of the fluid flow. Common uses of the centrifugal pump include lifting of water, sewage, paper pulp, petroleum and petrochemical pumping.

II. Relevant Program Outcomes (POs)

PO 1. ***Basic knowledge:*** *An ability to apply knowledge of basic mathematics, science and engineering to solve the engineering problems.*

PO 2. ***Discipline knowledge****: An ability to apply discipline - specific knowledge to solve core and/or applied engineering problems.*

PO 3. ***Experiments and practice:*** *An ability to plan and perform experiments and practices and to use the results to solve engineering problems.*

PO 4. ***Engineering tools:*** *Apply relevant civil technologies and tools with an understanding of the limitations.*

PO5. Individual and Team Work: *Function effectively as leader and team member in Diverse /multidisciplinary team*

III. Relevant Course Outcomes

Select relevant hydraulic pumps for different applications.

IV. Practical Outcome

Determine the efficiency of centrifugal pump.

V. Competency and Practical Skills

This practical is expected to develop the following skills for the industry identified competency, **"Apply hydraulics principles in water carriage systems and water retaining structures**

a. Measurement skill.
b. Identify components of centrifugal pump.
c. Demonstrate purpose /function of each component.
d. Observe and measure quantity of water delivered by pump.

VI. Relevant Affective domain related

a. Follow safety practices.
b. Demonstrate working as a leader/ team member.
c. Maintain tools and equipment.

VII. Minimum Theoretical Background

Centrifugal pumps are classified as roto dynamic type of pumps in which dynamic pressure is developed which enable the lifting of viscous liquids from lower to higher level. The basic principle on which a centrifugal pump works is that when a certain mass

of liquid is made to rotate by an external force. ,it is thrown away from the central axis of rotation .and a centrifugal head is impressed which enables it to rise to a higher level.

$$\textbf{overall efficiency} = \frac{w \times Q \times H_m}{\textbf{inputpower}.} \times 100\ \%$$

Where, w = Specific weight of liquid to be lifted N/ m^3.

Q = Discharge of pump m^3/ sec

H_m = Manometric Head m

Input power =.of the given pump

VIII. Experimental Set-up

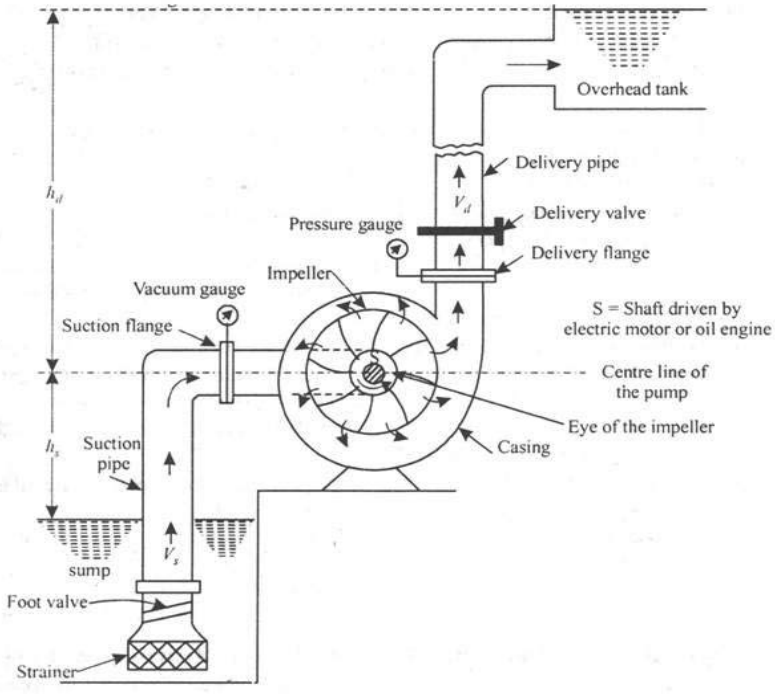

Figure 1. Component parts of Centrifugal Pump

IX. Resources required

Sr. No.	Particulars	Specification	Quantity	Remark (Photos)
1	Centrifugal pump with motor	Standard make	1	For each batch
2	Stop watch	Standard make	1	For each batch
3	Pressure gauge	Standard make	1	For each batch

X. Procedure:

1. Switch ON the pump.
2. Collect the discharge of liquid in the measuring tank and measure rise in height of water level in T seconds.
3. Observe and Record the suction and delivery pressure indicated by pressure gauges at suction and delivery pipe respectively.
4. .Note down the readings measuring tank.
5. Repeat the procedure for three readings.

XI. Precautions to be followed

1. Printing should be done before starting the pump.
2. Open all Valves Completely & never shut down delivery Valves.
3. See that foot Valves is immersed in the water tank.
4. Drain all tanks after the experiment.
5. Shut off the system completely.

XII. Actual procedure followed

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XIII. Resources used

Sr. No.	Name of Resource	Broad Specifications		Quantity	Remark
		Make	Details		
1					
2					
3					

XIV. Precautions followed

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XV. Observations

Sr. No	Rise in water level in tank h	Time of water collection in Tank T	Discharge Q = A x h/ T	Total Head Hm
1				
2				
3				

Sample Calculation

$$overall\ efficiency = \frac{w \times Q \times H_m}{inputpower\ .} \times 100\ \%$$

XVI. Results

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XVII. Interpretation of results

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XVIII. Conclusions and Recommendations (if any)

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XIX. Practical Related Questions

***Note**: Below given are few sample questions for reference. Teachers must design more such questions so as to ensure the achievement of identified CO. Write answers of minimum three questions.*

1. Write specifications pump used in this experiment.
2. Define priming of a pump and state its necessity.
3. For lifting sewage water which type of pump will be suitable and why?
4. Differentiate reciprocating and centrifugal pump.
5. State sequential steps of the working/operation of centrifugal pump.
6. State the make of centrifugal and reciprocating pump used in laboratory.
7. State the practical /day to day life situations where reciprocating pump is used.
8. Length of suction pipe is always less than delivery pipe? Give reason.

Space to Write Answers

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XX. References / Suggestions for further Reading

Sr. No.	Title of Book	Author	Publication
1	Hydraulics and Fluid Mechanics	Modi,P. N.and Seth, S.M.	Standard book house, Delhi *ISBN:*13: 978-8189401269;
2	Hydraulics, Fluid Mechanics and Fluid Machines	Ramamrutham, and Narayan,R.	Dhanpat Rai Publishing Company, New Delhi, **ISBN:**8187433841

XXI. Suggested Assessment Scheme

Performance Indicators		Weightage (%)
Process related: 15 Marks		**60%**
1	Performing the test /practical accurately	20%
2	Noting down the observations	30%
3	Working in team	10%
Product related: 10 Marks		**40%**
4	Conclusions	20%
5	Answer to practical related questions	10%
6	Submission of report in time	10%
Total : 25 Marks		**100%**

List of Student Team Members

1……

2……

3……

4……

Marks Obtained			Dated sign of Teacher
Process Related (15)	**Product Related (10)**	**Total (25)**	

List Of Laboratory Manuals Developed by MSBTE

First Semester:

1	Fundamentals of ICT	22001
2	English	22101
3	English Work Book	22101W
4	Basic Science (Chemistry)	22102
5	Basic Science (Physics)	22102

Second Semester:

1	Bussiness Communication Using Computers	22009
2	Computer Peripherals & Hardware Maintenace	22013
3	Web Page Design with HTML	22014
4	Applied Science (Chemistry)	22202
5	Applied Science (Physics)	22202
6	Applied Machines	22203
7	Basic Surveying	22205
8	Applied Science (Chemistry)	22211
9	Applied Science (Physics)	22211
10	Fundamental of Electrical Engineering	22212
11	Elements of Electronics Engineering	22213
12	Elements of Electrical Engineering	22215
13	Basic Electronics	22216
14	C Language programming	22218
15	Basic Electronics	22225
16	Programming in C	22226
17	Fundamental of Chemical Engineering	22231

Third Semester:

1	Applied Multimedia Techniques	22024
2	Advanced Serveying	22301
3	Highway Engineering	22302
4	Mechanics of Structures	22303
5	Building Construction	22304
6	Concrete Technology	22305
7	Strength Of Materials	22306
8	Automobile Engines	22308
9	Automobile Transmission System	22309
10	Mechanical Operations	22313
11	Technology Of Inorganic Chemicals	22314
12	Object Oriented Programming Using C++	22316
13	Data Structure Using 'C'	22317
14	Computer Graphics	22318
15	Database Management System	22319
16	Digital Techniques	22320
17	Principles Of Database	22321
18	Digital Techniques & Microprocessor	22323
19	Electrical Circuits	22324
20	Electrical & Electronic Measurment	22325
21	Fundamental Of Power Electronics	22326
22	Electrical Materials & Wiring Practice	22328
23	Applied Electronics	22329
24	Electrical Circuits & Networks	22330
25	Electronic Measurments & Instrumentation	22333
26	Principles Of Electronics Communication	22334
27	Thermal Engineering	22337
28	Engineering Matrology	22342
29	Mechanical Engineering Materials	22343
30	Theory Of Machines	22344

Fourth Semester:

1	Hydraulics	22401
2	Geo Technical Engineering	22404
3	Chemical Process Instrumentation & Control	22407
4	Fluid Flow Operation	22409
5	Technology Of Organic Chemical	22410
6	Java Programming	22412
7	GUI Application Development Using VB.net	22034
8	Microprocessor	22415
9	Database Managment	22416
10	Electric Motors And Transformers	22418
11	Industrial Measurement	22420
12	Digital Electronic And Microcontroller Application	22421
13	Linear Integrated Circuits	22423
14	Microcontroller & Applications	22426
15	Basic Power Electronics	22427
16	Digital Communication Systems	22428
17	Mechanical Engineering Measurments	22443
18	Fluid Mechanics and Machinery	22445
19	Fundamentals Of Mechatronics	22048
20	Micro Project & Industrial Training Assessment Manual	22049

Fifth Semester:

1	Network Management & Administration	17061
2	Solid Modeling	17063
3	CNC Machines	17064
4	Behavioral Science(Hand Book)	17075
5	Behavioral Science (Assignment Book)	17075
6	Windows Programming using VC++	17076
7	Estimation and Costing	17501
8	Public Health Engineering	17503
9	Concrete Technology	17504
10	Design of Steel Structures	17505
11	Switchgear and Protection	17508
12	Microprocessor & Application	17509
13	A.C. Machines	17511
14	Operating System	17512
15	Java Programming	17515
16	System Programming	17517
17	Communication Technology	17519
18	Hydraulic & Pneumatics	17522
19	Advanced Automobile Engines	17523
20	Basic Electrical & Electronics	17524
21	Measurement and Control	17528
22	Power Engineering	17529
23	Metrology & Quality Control	17530
24	Computer Hardware & Networking	17533
25	Microcontroller	17534
26	Digital Communication	17535
27	Control System & PLC	17536
28	Audio Video Engineering	17537
29	Control System	17538
30	Industrial Electronics and applications	17541
31	Heat Transfer Operations	17560
32	Chemical Process Instrumentation & control	17561

Sixth Semester:

1	Solid Modeling	17063
2	Highway Engineering	17602
3	Contracts & Accounts	17603
4	Design of R.C.C. Structures	17604
5	Industrial Fluid Power	17608
6	Design of Machine Elements	17610
7	Automotive Electrical and Electronic Systems	17617
8	Vehicle Systems Maintenance	17618
9	Software Testing	17624
10	Advanced Java Programming	17625
11	Mobile Computing	17632
12	System Programing	17634
13	Testing & Maintenance of Electrical Equipments	17637
14	Power Electronics	17638
15	Illumination Engineering	17639
16	Power System Operation & Control	17643
17	Environmental Technology	17646
18	Mass Transfer Operation	17648
19	Advanced Communication System	17656
20	Mobile Communication	17657
21	Embedded System	17658
22	Process Control System	17663
23	Industrial Automation	17664
24	Industrial Drives	17667
25	Video Engineering	17668
26	Optical Fiber & Mobile Communication	17669
27	Therapeutic Equipment	17671
28	Intensive Care Equipment	17672
29	Medical Imaging Equipment	17673

Pharmacy Lab Manual

First Year:

1	Pharmaceutics - I	0805
2	Pharmaceutical Chemistry - I	0806
3	Pharmacognosy	0807
4	Biochemistry and Clinical Pathology	0808
5	Human Anatomy and Physiology	0809

Second Year:

1	Pharmaceutics - II	0811
2	Pharmaceutical Chemistry - II	0812
3	Pharmacology & Toxicology	0813
4	Hospital and Clinical Pharmacy	0816

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