Ref No:

SRI KRISHNA INSTITUTE OF TECHNOLOGY, BANGALORE

COURSE PLAN

Academic Year 2019-20

Program:	BE – MECHANICAL ENGINEERING
Semester :	5
Course Code:	17MEL57
Course Title:	FLUID MECHANICS & MACHINERY LAB
Credit / L-T-P:	2 / 1-0-2
Total Contact Hours:	36
Course Plan Author:	Naveen Kumar Pattar/Dinesh P

Academic Evaluation and Monitoring Cell

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INSTRUCTIONS TO TEACHERS

- Classroom / Lab activity shall be started after taking attendance.

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

Table of Contents

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

17MEL57:Fluid Mechanics and Machinery Lab

A. LABORATORY INFORMATION

1. Laboratory Overview

Degree:	BE	Program:	ME
Year / Semester :	3 / 5	Academic Year:	2019-20
Course Title:	Fluid mechanics and machinery lab	Course Code:	17MEL57
Credit / L-T-P:	2 / 1-0-2	SEE Duration:	180 Minutes
Total Contact Hours:	36 Hrs	SEE Marks:	60Marks
CIA Marks:	40	Assignment	---
Lab. Plan Author:	Naveen Kumar Pattar/Dinesh P	Sign	Dt :18/8/2019
Checked By:	B M Krishne Gouda	Sign	Dt :

2. Laboratory Content

Expt #	Title of the Experiments	Lab Hours	Concept	Blooms Level
1	Lab layout, calibration of instruments and standards to be discussed	3	-	-
2	Determination of coefficient of friction of flow in a pipe.	3	Friction factors by various c/s pipes	L3 Apply
3	Determination of minor losses in flow through pipes	3	Losses through pipes	L3 Apply
4	Application of momentum equation for determination of coefficient of impact of jets on flat and curved blades	3	Impact jet	L3 Apply
5	Calibration of flow measuring devices Orifice meter, Nozzle, Venturi meter , V-notch.	3	Fluid flow	L3 Apply
6	Performance on hydraulic Turbines a. Pelton wheel b. Francis Turbine c. Kaplan Turbines	3	Performance characteristics of turbine	L3 Apply
7	Performance hydraulic Pumps a. Single stage and Multi stage centrifugal pumps b. Reciprocating pump	3	Performance characteristics of pumps	L3 Apply
8	Performance test on a two stage Reciprocating Air C compressor	3	Characteristic parameter for air compressor	L3 Apply
9	Performance test on an Air Blower	3	Characteristic parameter for air blower	L3 Apply

3. Laboratory Material

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

Expt.	Details	Expt. in book	Availability
	Text books		
2-5	K.L.Kumar.“Engineering Fluid Mechanics” Experiments, Eurasia Publishing House, 1997		In Library
6-9	Jagdish Lal, Hydraulic Machines, Metropolitan Bo ok Co, Delhi, 1995		
B	**Reference books**		
6-9	George E. Totten Victor J. De Negri “Handbook of Hydraulic Fluid Technology, Second Edition, 2011		In Library

C	**Concept Videos or Simulation for Understanding**		
1	uorepc-nitk.vlabs.ac.in		
2	https://www.youtube.com/watch? v=UDF448c6fOw		
3	https://www.tutorialspoint.com/videotutorials/index.htm		
4	https://skl.sh/practicalengineering3		
5	https://www.tutorialspoint.com/videotutorials/index.htm Lecture By: Er. Himansu		
6	- https://drive.google.com/open?id=1utMdeMujjiJwBuCD4r0fcflx0XAp4u9E ...		
7	https://www.tutorialspoint.com/videotutorials/index.htm ...		
8	https://amzn.to/2CWIed8		
D	**Software Tools for Design**	-	-
E	**Recent Developments for Research**	-	-
F	**Others (Web, Video, Simulation, Notes etc.)**	-	-
1	https://nptel.ac.in/courses/fluidmechanics.nit/		

4. Laboratory Prerequisites:

Refer to GL01. If prerequisites are not taught earlier, GAP in curriculum needs to be addressed. Include in Remarks and implement in B.5.

Students must have learnt the following Courses / Topics with described Content . . .

Expt.	Lab. Code	Lab. Name	Topic / Description	Sem	Remarks	Blooms Level
1	17EME15	Elements Of Mechanical Engineering	Mechanical Properties of turbines	1	Plan Gap Course	L2
2	17MEL57	Fluid mechanics	Fluid properties, Fluid flows, variation in fluid flows, turbulent and laminar flow.	3	Plan Gap Course	L2

5. Content for Placement, Profession, HE and GATE

The content is not included in this course, but required to meet industry & profession requirements and help students for Placement, GATE, Higher Education, Entrepreneurship, etc. Identifying Area / Content requires experts consultation in the area.

Topics included are like, a. Advanced Topics, b. Recent Developments, c. Certificate Courses, d. Course Projects, e. New Software Tools, f. GATE Topics, g. NPTEL Videos, h. Swayam videos etc.

Expt.	Topic / Description	Area	Remarks	Blooms Level
6	Fluid Mechanics and Performance of turbines	GATE	NPTEL Videos	L3

B. Laboratory Instructions

1. General Instructions

SNo	Instructions	Remarks
1	Observation book and Lab record are compulsory.	
2	Students should report to the concerned lab as per the time table.	
3	After completion of the program, certification of the concerned staff in-charge in the observation book is necessary.	
4	Student should bring a notebook of 100 pages and should enter the readings /observations into the notebook while performing the experiment.	

5	The record of observations along with the detailed experimental procedure of the experiment in the Immediate last session should be submitted and certified staff member in-charge.	
6	Should attempt all problems / assignments given in the list session wise.	
7	It is responsibility to create a separate directory to store all the programs, so that nobody else can read or copy.	
8	When the experiment is completed, should disconnect the setup made by them, and should return all the components/instruments taken for the purpose.	
9	Any damage of the equipment or burn-out components will be viewed seriously either by putting penalty or by dismissing the total group of students from the lab for the semester/year	
10	Completed lab assignments should be submitted in the form of a Lab Record in which you have to write the algorithm, program code along with comments and output for various inputs given	

2. Laboratory Specific Instructions

SNo	Specific Instructions	Remarks
1	Students must attend the lab classes with ID cards and in the prescribed uniform.	
2	Students must check if the components, instruments and machinery are in working condition before setting up the experiment.	
3	Power supply to the experimental set up/ equipment/ machine must be switched on only after the faculty checks and gives approval fording the experiment. Students must start to the experiment. Students must start doing the experiments only after getting permissions from the faculty.	
4	Students may contact the lab in charge immediately for any unexpected incident sand emergency	
5	The apparatus used for the experiments must be cleaned and returned to the technicians, safely without any damage	
6	Make sure, while leaving the lab after the stipulated time, that all the power connections are switched off	

C. OBE PARAMETERS

1. Laboratory Outcomes

Expt.	Lab Code #	COs / Experiment Outcome	Teach. Hours	Concept	Instr Method	Assessment Method	Blooms' Level
-	-	**At the end of the experiment, the student should be able to . . .**	-	-	-	-	-
1	17MEL57.1	Calculate co-efficient of friction through pipes	3	Friction factors by various c/s pipes	Demonstrate chalk and Bord	Practical record and IA test	L3 Apply
2	17MEL57.2	Calculate different losses in pipes	3	Losses through pipes	Demonstrate chalk and Bord	Practical record and IA test	L3 Apply
3	17MEL57.3	Calculate impact jet on planes	3	Impact jet	Demonstrate chalk and Bord	Practical record and IA test	L3 Apply
4	17MEL57.4	Calculate total discharge through flow measuring devises	9	Fluid flow	Demonstrate chalk and Bord	Practical record and IA test	L3 Apply
5	17MEL57.5	Calculate flow pattern through the hydraulic turbine	6	Performance characteristics of turbine	Demonstrate chalk and	Practical record and IA test	L3 Apply

					Bord			
6	17MEL57.6	Illustrate flow pattern through the hydraulic pumps	6	Performance characteristics of pumps	Demonstrate chalk and Bord	Practical record and IA test	L3 Apply
7	17MEL57.7	Calculate the characteristic performance for air-compressor	3	Characteristic parameter for air compressor	Demonstrate chalk and Bord	Practical record and IA test	L3 Apply
8	17MEL57.8	Calculate the characteristic performance for air-blower	3	Characteristic parameter for air blower	Demonstrate chalk and Bord	Practical record and IA test	L3 Apply
-		**Total**	**36**	-	-	-	-

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

2. Laboratory Applications

Expt.	Application Area	CO	Level
1	Design of flow pipes	CO1	L3
2	Power generating sector like turbine houses	CO2	L3
3	Bernoulli's Principle application areas	CO3	L3
4	Jet fowl, calculations. Impulse turbine blade design	CO4	L3
5	Discharge calculations in dams and channels	CO5	L3
6	Power producing machines	CO6	L3
7	Efficiency of turbines	CO7	L3
8	Vehicle Air Blower testing	CO8	L3
9	Hair drier	CO9	L3

Note: Write 1 or 2 applications per CO.

3. Mapping And Justification

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

Expt.	Mapping		Mapping Level	Justification for each CO-PO pair	Level
-	**CO**	**PO**	-	**'Area': 'Competency' and 'Knowledge' for specified 'Accomplishment'**	-
1	CO1	PO1	L2	'Engineering Knowledge:'Acquisition of Engineering_Knowledge is required to understand the different performance of flow in friction through pipes to accomplish solutions to complex engineering_problems in Mechanical Engineering.	L3
1	CO1	PO2	L3	'Problem Analysis': Analyzing problems require knowledge of / understanding flow in a friction to accomplish solutions to complex engineering problems in Mechanical engineering.	L3
1	CO1	PO9	L2	'Individual work':Coefficient of friction through flow in a pipe function can be find effectively as an individual.	L3
2	CO2	PO1	L2	Engineering Knowledge:'Acquisition of Engineering_Knowledge is required to understand the different losses in the flow through pipes to accomplish solutions to complex engineering_problems in Mechanical Engineering.	L3
2	CO2	PO2	L3	'Problem Analysis': Analyzing problems require knowledge of / understanding different major and minor losses in pipes to accomplish solutions to complex engineering problems in Mechanical engineering.	L3
2	CO2	PO9	L2	'Individual work':Different losses in flow through pipe in a pipe function can be find effectively as an individual.	L3
3	CO3	PO1	L3	'Engineering Knowledge:'Acquisition of Engineering_Knowledge is required to	L3

				understand the coefficient of jet on plate to accomplish solutions to complex engineering_problems in Mechanical Engineering.	
3	CO3	PO2	L3	'Problem Analysis': Analyzing problems require knowledge of understanding coefficient of discharge in a jet on plate to accomplish solutions to complex engineering problems in Mechanical engineering.	L3
3	CO3	PO9	L2	'Individual work':coefficient of discharge in a jet on plate in a pipe function can be find effectively as an individual.	L3
4	CO4	PO1	L2	'Engineering Knowledge:'Acquisition of Engineering_Knowledge is required to understand the coefficient of discharge through flow measuring devices to accomplish solutions to complex engineering_problems in Mechanical Engineering.	L3
4	CO4	PO2	L3,L6,L4	'Problem Analysis': Analyzing problems require knowledge of understanding coefficient of discharge in an venturi, orifice meters through to accomplish solutions to complex engineering problems in Mechanical engineering.	L3
4	CO4	PO9	L2	'Individual work':coefficient of discharge in venturi and orifice in a pipe function can be find effectively as an individual.	L3
5	CO5	PO1	L2	'Engineering Knowledge:'Acquisition of Engineering_Knowledge is required to understand the flow patterns in the different hydraulic turbines to accomplish solutions to complex engineering_problems in Mechanical Engineering.	L3
5	CO5	PO2	L3	'Problem Analysis': Analyzing problems require knowledge of understanding performance characteristics of different hydraulic turbines to accomplish solutions to complex engineering problems in Mechanical engineering.	L3
5	CO5	PO9	L2	'Team work':Performance characteristics of hydraulic turbine can be find effectively as a team.	L3
6	CO6	PO1	L2	'Engineering Knowledge:'Acquisition of Engineering_Knowledge is required to understand the flow patterns in the different hydraulic pumps to accomplish solutions to complex engineering_problems in Mechanical Engineering.	L3
6	CO6	PO2	L3	'Problem Analysis': Analyzing problems require knowledge of understanding performance characteristics of different hydraulic pumps to accomplish solutions to complex engineering problems in Mechanical engineering.	L3
6	CO6	PO9	L2	'Team work':Performance characteristics of hydraulic pumps can be find effectively as a team.	L3
7	CO7	PO1	L3	'Engineering Knowledge:'Acquisition of Engineering_Knowledge is required to understand the Performance of an air compressor to accomplish solutions to complex engineering_problems in Mechanical Engineering.	L3
7	CO7	PO2	L3	'Problem Analysis': Analyzing problems require knowledge of understanding performance characteristics of an air compressor to accomplish solutions to complex engineering problems in Mechanical engineering.	L3
7	CO7	PO9	-	'Team work':Performance characteristics of air compressor can be find effectively as a team.	L3
8	CO8	PO1	L2	'Engineering Knowledge:'Acquisition of Engineering_Knowledge is required to understand the Performance of an air blower to accomplish solutions to complex engineering_problems in Mechanical Engineering.	L3
8	CO8	PO2	L3	'Problem Analysis': Analyzing problems require knowledge of understanding performance characteristics of an air blower to accomplish solutions to complex engineering problems in Mechanical engineering.	L3
8	CO8	PO9	L3	'Team work':Performance characteristics of air blower can be find effectively as a team.	L3

4. Articulation Matrix

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

-	-	Experiment Outcomes	Program Outcomes															-
Expt.	CO.#	**At the end of the experiment**	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PO	PS	PS	PS	Lev

		student should be able to . . .	1	2	3	4	5	6	7	8	9	10	11	12	O1	O2	O3	el
1	17MEL57.1	Calculate co-efficient of friction through pipes	2	3	-	-	-	-	-	-	2	-	-	-	-	-	-	L3
2	17MEL57.2	Calculate different losses in pipes	2	3	-	-	-	-	-	-	2	-	-	-	-	-	-	L3
3	17MEL57.3	Calculate impact jet on planes	2	2	-	-	-	-	-	-	2	-	-	-	-	-	-	L3
4	17MEL57.4	Calculate total discharge through flow measuring devises	2	3	-	-	-	-	-	-	2	-	-	-	-	-	-	L3
5	17MEL57.5	Calculate flow pattern through the hydraulic turbine	2	3	-	-	-	-	-	-	2	-	-	-	-	-	-	L3
6	17MEL57.6	Illustrate flow pattern through the hydraulic pumps	2	2	-	-	-	-	-	-	2	-	-	-	-	-	-	L3
7	17MEL57.7	Calculate the characteristic performance for air-compressor	2	2	-	-	-	-	-	-	2	-	-	-	-	-	-	L3
8	17MEL57.8	Calculate the characteristic performance for air-blower	2	2	-	-	-	-	-	-	2	-	-	-	-	-	-	L3
-	**17MEL57**	**Average attainment (1, 2, or 3)**	**2**	**2.5**							**2**							**-**
-	*PO, PSO*	*1.Engineering Knowledge; 2.Problem Analysis; 3.Design / Development of Solutions; 4.Conduct Investigations of Complex Problems; 5.Modern Tool Usage; 6.The Engineer and Society; 7.Environment and Sustainability; 8.Ethics; 9.Individual and Teamwork; 10.Communication; 11.Project Management and Finance; 12.Life-long Learning; S1.Software Engineering; S2.Data Base Management; S3.Web Design*																

5. Curricular Gap and Experiments

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

Expt	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Flow Measuring Devices concept	Seminar	15/10/2019	Self	PO2
2	Air Blower Working Principle	NPTEL Videos	4/11/2019	-	PO2

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

6. Experiments Beyond Syllabus

Topics & contents required (from A.5) not addressed, but help students for Placement, GATE, Higher Education, Entrepreneurship, etc.

Expt	Gap Topic	Actions Planned	Schedule Planned	Resources Person	PO Mapping
1	Analysis of orifice and venturi meter	NPTEL Videos	15/10/2019	-	PO2

D. COURSE ASSESSMENT

1. Laboratory Coverage

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

Unit	Title	Teaching Hours	No. of question in Exam							CO	Levels
			CIA-1	CIA-2	CIA-3	Asg-1	Asg-2	Asg-3	SEE		
1	Lab layout, calibration of instruments and standard s to be discussed	03	1	-	-	-	-	-	1	CO1	L2
2	Determination of coefficient of friction of flow in a pipe.	03	1	-	-	-	-	-	1	CO2	L3
3	Determination of minor losses in flow through pipes	03	1	-	-	-	-	-	1	CO3	L3
4	Application of momentum equation for determination of coefficient of impact of jets on flat and curved blades	03	1	-	-	-	-	-	1	CO4	L3

5	Calibration of flow measuring devices Orifice meter, Nozzle, Venturi meter , V-notch.	06	-	2	-	-	-	-	2	CO5	L3
6	Performance on hydraulic Turbines a. Pelton wheel b. Francis Turbine c. Kaplan Turbines	06	-	2	-	-	-	-	2	CO6	L3
7	Performance hydraulic Pumps a. Single stage and Multi stage centrifugal pumps b. Reciprocating pump	06	-	-	2	-	-	-	2	CO7	L3
8	Performance test on a two stage Reciprocating Air C compressor	03	-	-	1	-	-	-	1	CO8	L3
9	Performance test on an Air Blower	03	-	-	1	-	-	-	1	CO9	L3
-	**Total**	**36**	**4**	**4**	**4**	**-**	**-**	**-**	**12**		**L3**

2. Continuous Internal Assessment (CIA)

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

Evaluation	Weightage in Marks	CO	Levels
CIA Exam – 1	40	CO1, CO2, CO3, CO4	L3
CIA Exam – 2	40	CO5, CO6	L3
CIA Exam – 3	40	CO7, CO8,CO9	L3
	-	-	-
Other Activities – define – Slip test	-	-	-
Final CIA Marks	**40**	**C01-CO9**	**L3**

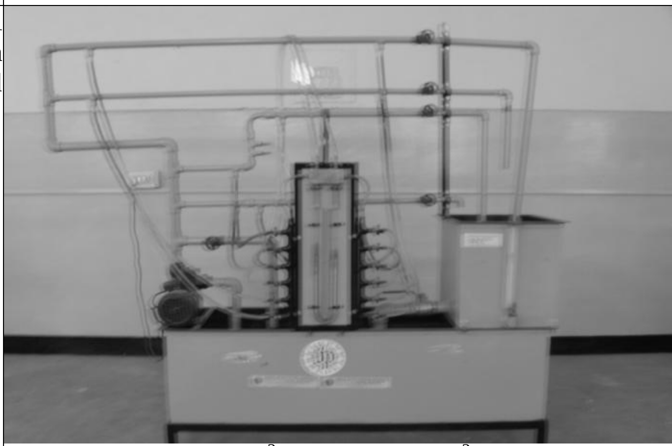
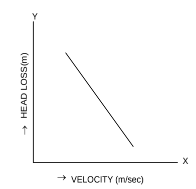
-

SNo	Description	Marks
1	Observation and Weekly Laboratory Activities	10 Marks
2	Record Writing / Viva	15 Marks for each Expt
3	Internal Exam Assessment	15 Marks
4	Internal Assessment	40 Marks
5	SEE	60 Marks
-	**Total**	**100 Marks**

E. EXPERIMENTS

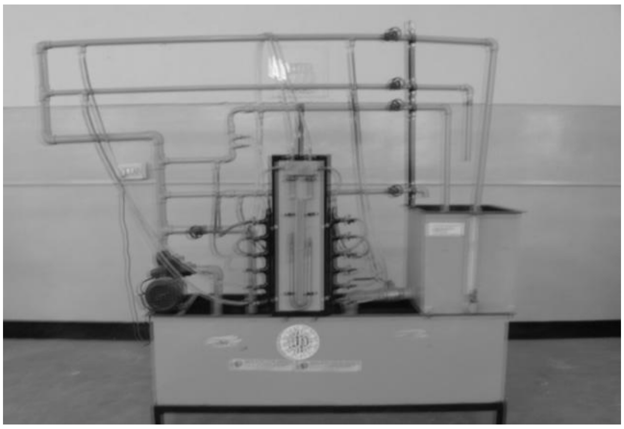
Experiment 01 : Calculate co-efficient of friction through pipes

-	**Experiment No.:**	1	**Marks**	15	**Date Planned**		**Date Conducted**	
1	Title	**Calculate co-efficient of friction through pipes**						
2	Course Outcomes	Calculate co-efficient of friction through pipes						
3	Aim	Determine coefficient of friction for pipes and head loss in pipe friction						
4	Material / Equipment Required	Pipe friction apparatus , stop watch						
5	Theory, Formula, Principle, Concept	To find co-efficient of friction,$f=hf*2gd/alv^2$, Friction factors by various c/s pipes						
6	Procedure, Program,	❿ step 1: Before starting flow through pipes the initial manometer reading is taken.						

	Activity, Algorithm, Pseudo Code	step 2: Then the fluid is allowed to flow through pipes. step 3: Then the manometer reading on the pipe is taken down. Step 4: Take the time required for 100 mm rise in water level in measuring tank step 5:Take at least 3 readings. step 6: Above procedure is repeated for different discharges
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	 - $v=Q/a, hf=4lv^2/2gd, f=h_f 2gd/4lv^2$
8	Observation Table, Look-up Table, Output	(see table below)
9	Sample Calculations	-Frictional Head Loss (h_f) = ((h_1+ h_2) / 100) x 12.6 -Velocity V= Q/a in m/sec - $h_f = \frac{f \times L \times V^2}{2gd}$ - $f = \frac{h_f \times 2gd}{L \times V^2}$
10	Graphs, Outputs	IDEAL GRAPH OF FRICTION IN PIPES (FOR DIA 17 mm) 
11	Results & Analysis	a) Head loss due to pipe friction for ø 22 mm pipe is h_f = ………m b) Coefficient of friction for diameter 22 mm pipe is = -----------
12	Application Areas	Calculate pressure drop velocities and Reynolds Number applications
13	Remarks	
14	Faculty Signature with Date	

Diameter Of pipe in mm	Trial No	Manometer reading in cm	Frictional head loss $h_f = \frac{(H_1 \pm H_2)}{100} \times 12.6$ in m	Time required for 100 mm rise in water level (t) in sec	Discharge of Head $Q = \frac{(A \times h)}{t}$ in m^3/sec	Velocity of Water fow $V= \frac{Q}{a}$ in m^3/sec	Coefficient of friction $f = \frac{h_f \times 2gd}{LV^2}$
		H_1	H_2				
For 22 mm	1 2 3						
For 17 mm	1 2 3						

Experiment 02 : Determination of minor losses in flow through pipes

-	Experiment No.:	1	Marks	15	Date Planned		Date Conducted	
1	Title	**Determination of minor losses in flow through pipes**						
2	Course Outcomes	Calculate different losses in pipes						
3	Aim	To determine different losses due to pipe fitting						
4	Material / Equipment Required	Set of pipe fitting apparatus, stop watch						
5	Theory, Formula, Principle, Concept	Losses through pipes, H_x=(h1+h2/1000)*12.6, $h_{em}=(v1-v2)^2/2g$						
h6	Procedure, Program, Activity, Algorithm, Pseudo Code	❿ step 1: Before starting flow through pipes the initial manometer reading is taken. ❿ step 2: Then the fluid is allowed to flow through pipes. ❿ step 3: Then the manometer reading on the pipe is taken down. ❿ step 4:Take the time required for 100 mm rise in water level in measuring tank ❿ step 5:Take at least 3 readings. ❿ step 6: Above procedure is repeated for different discharges						
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	 Head loss (Elbow) $he = \frac{0.25\, v^2}{2g}$ Head loss (Contraction) $hc = \frac{0.5\, v^2}{2g}$ Head loss (Enlargement) $h_{en} = \frac{(v_1-v_2)^2}{2g}$						
8	Observation Table, Look-up Table, Output							

Type of fitting	Trail Nos	Manometer reading in cm	Differential Head of Manometer	Time required for 100 mm rise of water level	Discharge Q = A x h / t in m^3/sec	Area of corresponding Pipe 'a' in m^2	Velocity of Flow V in m/sec	Frictional head loss h_f in m

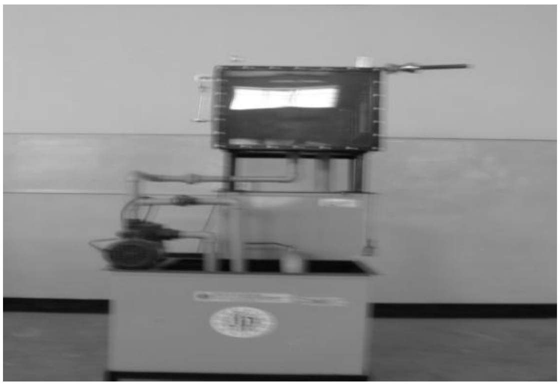
			$H=\frac{(h_1 \pm h_2)}{100} * 12.6$ in m	(t) in sec				
		h_1	h_2					
BEND	1 2 3							
ELBOW	1 2 3							
CONTRACTION	1 2 3							
ENLARGEMENT	1 2 3						a_1	a_2

9	Sample Calculations	1) Heat lost due to Friction in m of water **H** = (H_1+H_2 /100) x12.6 2) Velocity V = Q/a in m/s
10	Graphs, Outputs	
11	Results & Analysis	1. Head loss due to friction in bend h_b = ----------------- 2. Head loss due to friction in elbow h_e = ----------------- 3. Head loss due to friction in sudden contraction h_c = ----------------- 4. Head loss due to friction in sudden enlargement h_e = -----------------
12	Application Areas	Design of flow pipes
13	Remarks	
14	Faculty Signature with Date	

Experiment 03 :Application of momentum equation for determination of coefficient of impact of jets on flat and curved blades

-	**Experiment No.:**	1	**Marks**	15	**Date Planned**		**Date Conducted**	
1	Title	**Application of momentum equation for determination of coefficient of impact of jets on flat and curved blades**						
2	Course Outcomes	Calculate impact jet on planes						
3	Aim	Determination of force developed by impact of jet on vanes						
4	Material / Equipment Required	Impact of jet apparatus , Standard dead weights, Stop watch						
	Theory, Formula, Principle, Concept	Coefficient impact of jet $K = \frac{F\ act}{F\ the}$						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: First balance the lever mechanism to zero. Step 2: Again balance the lever mechanism by loading weights on the other side lever mechanism. Step 3: Take the time required for 100mm raise in water level of measuring tank Step 4: Above procedure is repeated for different discharges. Step 5: Thus calculate the impact forces. step 6: Above procedure is same for inclined plate.						

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



$$F_{act} = \frac{W * X}{Y} \text{ N}$$

W = loaded weight in N
X = 480mm = 0.48m
Y = 185mm = 0.185m

8	Observation Table, Look-up Table, Output	see below

Sl No	Weights		Time required for 100mm rise of water level (t) in sec	Discharge of jet Q in m^3/sec	Velocity V in m/s	Theoretical force F_{the} in N	Actual force F_{act} in N	Coefficient impact of jet
	In Grams	In Newton						
1								
2								

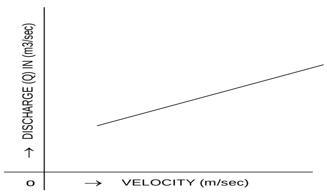
9	Sample Calculations	see below

$$F_{the} = \frac{\delta_w * a * v^2}{g} * \sin^2\theta \quad \text{(in the direction of flow)}$$

$$F_{the} = \frac{\delta_w * a * v^2}{\ } * \sin^2\theta \quad \text{(in the direction normal to flow).}$$

10	Graphs, Outputs	see below

IDEAL GRAPH OF IMPACT OF JET

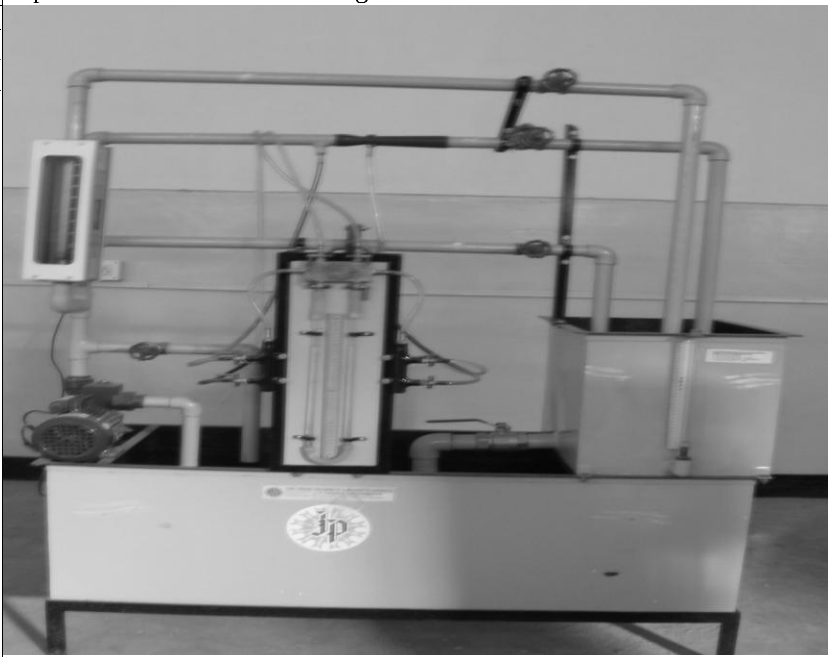


11	Results & Analysis	The coefficient of impact of a jet striking a flat plate is = -------------------
12	Application Areas	Power generating sector like turbine houses
13	Remarks	
14	Faculty Signature with Date	

Experiment 04 : Calibration of flow measuring devices Orifice meter, Nozzle ,Venturi meter , V-notch.

-	Experiment No.:	1	Marks	15	Date Planned		Date Conducted	

1	Title	Calibration of flow measuring devices Orifice meter, Nozzle, Venturi meter , V-notch.
2	Course Outcomes	Calculate total discharge through flow measuring devises
3	Aim	To measure the discharge through venturi meter & orifice meter.
4	Material / Equipment Required	Set up of venturi meter & orifice meter, stop watch.
5	Theory,Formula, Principle, Concept	$\mathbf{C_d} = \dfrac{Q_{act}}{Q_{the}}$
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: First open the by pass, pipe valves completely and close all the manometer tapings Step 2: Start the motor. Step 3: First take the discharge through venturi meter and take the following readings a) manometer reading) time required for 100mm rise in water level. Step 4: For taking discharge through venturi meter –a) close the orifice valve and open the venturi meter valve completely .b) open the manometer, tapping of venturi meter c) control the flow with help of by pass valve provided. Step 5: Repeat the above procedure for different discharges step 6: Take at least 3 or 4 readings.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	(see below)
8	Observation Table, Look-up Table, Output	(see below)

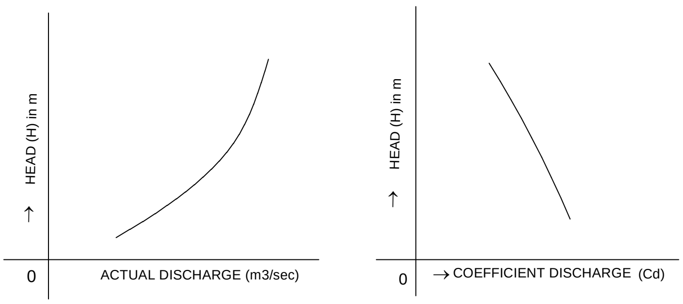


1 Theoretical discharge :-

$$Q_{the} = \frac{a_{1} * a_{2}}{\sqrt{(a_1^2 - a_2}} \times \sqrt{(2gH)} = C\sqrt{H} \text{ in } m^3 / sec$$

Sl No	Manometer Reading in cm		Head of water through venturimeter /	Time taken for 100 mm rise of water level (t)	Theoretical Discharge Qthe in m^3/sec	Actual Discharge Qact in m^3/sec	Coefficient Of discharge C_d
	h1	h2					

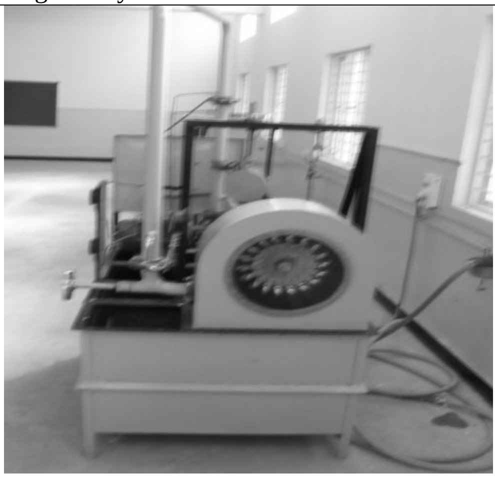
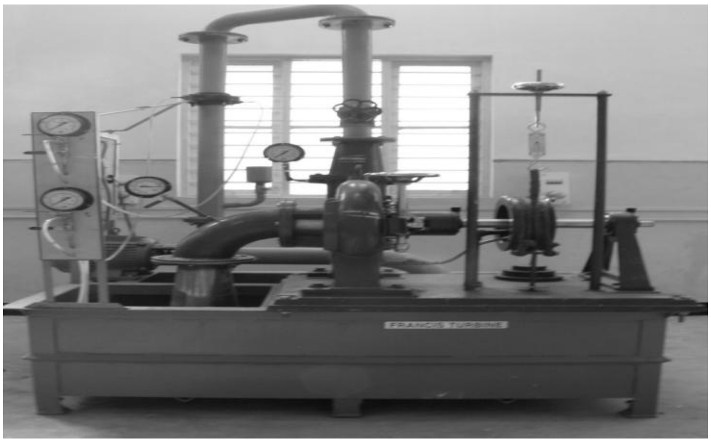
					orifice meter $H = \underline{h_1+h_2}$ x 12.6 100 in m	**in sec**			
		1							

9	Sample Calculations	
10	Graphs, Outputs	IDEAL GRAPH OF VENTURIMETER 
11	Results & Analysis	The given venturi meter has been calibrated & the average coefficient of discharge is found to be **C_d (avg) = ……….**
12	Application Areas	Bernoulli's Principle application areas
13	Remarks	
14	Faculty Signature with Date	

Experiment 05 : Performance on hydraulic Turbines

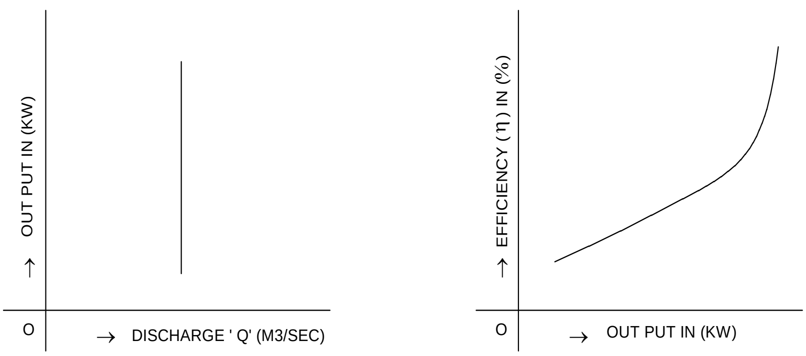
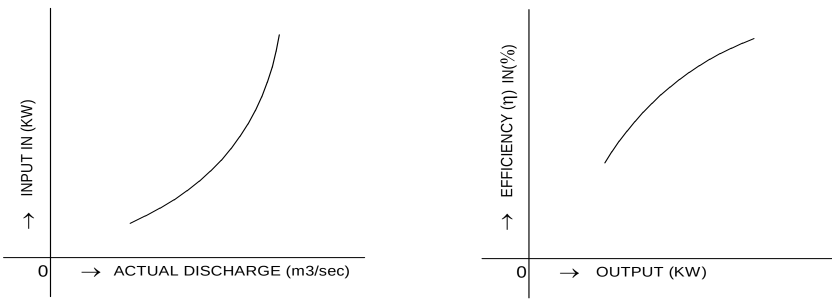
a. Pelton wheel
b. Francis Turbine
c. Kaplan Turbines

-	**Experiment No.:**	1	**Marks**	15	**Date Planned**		**Date Conducted**	
1	Title	Performance on hydraulic Turbines						
2	Course Outcomes Calculate flow pattern through the hydraulic turbine	Calculate flow pattern through the hydraulic turbine						
3	Aim	Performance testing of pelton wheel turbine Performance testing of Francis turbine						
4	Material / Equipment Required	Experimental setup for Pelton wheel turbine ,Standard weights, Tachometer.						
5	Theory, Formula, Principle, Concept	$\eta = \frac{\text{Out put power}}{\text{Input power}} \times 100$ $O/P = \frac{2 .\pi .N. T * 9.81}{60 * 1000}$ KW						

6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Keep the gate valve in the pipe line open and start the motor. Step 2: Gradually close the gate valve & apply certain load. Step 3: Gradually close the gate valve & bring the speed of runner to rotated valve. Step 4: Note the following readings a) pressure gauges reading. b) spring balance reading. c) speed of the runner. Step 5: Take at least 6-7 readings, keeping speed of the turbine constant. step 6: Tabulate the readings neatly**.**
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	  H = Px10 $$\mathbf{Q} = \frac{Cd * a_1 * a_2}{\sqrt{(a_1^2 - a_2^2)}} \times \sqrt{(2gh)}.$$ $$IP = \frac{\delta w * g * Q * H}{1000}$$

8	Observation Table, Look-up Table, Output	**Sl No**	**Load added (W)**	**Pressure gauge reading of**	**Head of orificemeter**	**Inlet pressure Of**	**Head of turbine**

			orificemeter			**turbine**	
	W in kgs	**W in N (w x 9.81)**	**P_1 (kg/cm^2)**	**P_2 (kg/cm^2)**	**h =(p_1~ p_2)10 m of water**	**P (kg/cm^2)**	**H=(Px10) in m**

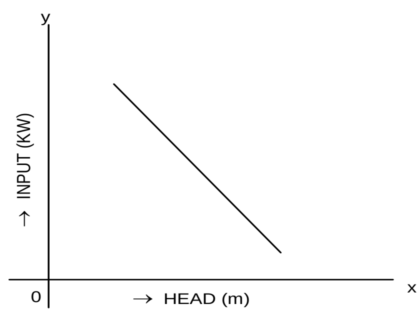
9	Sample Calculations	
10	Graphs, Outputs	IDEAL GRAPH OF PELTON WHEEL [FOR CONSTANT HEAD]  IDEAL GRAPH OF FRANCIS TURBINE [FOR CONSTANT SPEED] 
11	Results & Analysis	The experiment to study the characteristics of the pelton wheel has been conducted successfully and the average efficiencies 1. At constant head η_{avg} = …………in (%) 2. At constant speed η_{avg} = …………in (%)
12	Application Areas	Power plants
13	Remarks	
14s	Faculty Signature with Date	

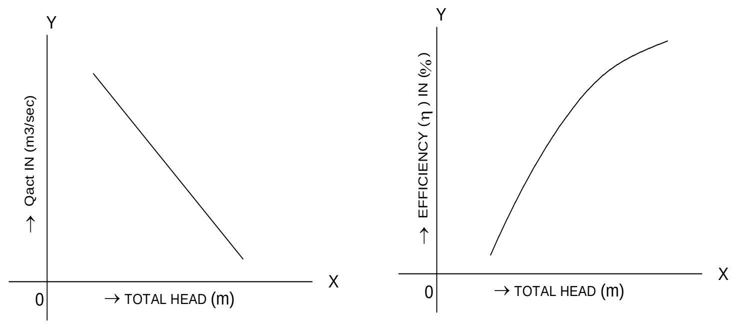
Experiment 06 : Performance hydraulic Pumps

a. Single stage and Multi stage centrifugal pumps
b. Reciprocating pump

-	Experiment No.:	1	Marks	15	Date Planned		Date Conducted	
1	Title	**Performance hydraulic Pumps**						
2	Course Outcomes	illustrate flow pattern through the hydraulic pumps						
3	Aim	*To determine the performance of single stage centrifugal pump. *						
4	Material / Equipment Required	Single stage centrifugal pump setup, stop watch , Tacho meter.						
5	Theory, Formula, Principle, Concept	**4) Efficiency (η)** $$\eta = \frac{\text{Out put power}}{\text{Input power}} \times 100 \quad \text{in (\%)}$$						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Prime the pump with water. Step 2:Start the motor Step 3: Note down the following readings. a) Vacuum gauge reading. b) Pressure gauge reading. c) Time required for 10 flash of energy meter. d) Time required for 100 mm of water level in measuring tank Step 4: Vary the position of gate valve in delivery pipe. Step 5: Repeat the above procedure for different discharges.						
7	Observation Table, Look-up Table, Output							

Sl No	Suction head (Hs)		Delivery head (H_d)		Total head $H=(Hs+H_d)+Z$ In m	Time required for 10 flashes (T) in sec	Time required for100mm rise of water level in measuring tank (t) in sec	Discharge (Q) in m^3/sec	Input power (IP) in KW	Out put power (OP) in KW	Efficiency η in (%)
	mm of Hg	m of H_2O	Kg/cm^2	m of H_2O							

		1											
8	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	 											
9	Sample Calculations												
10	Graphs, Outputs	IDEAL GRAPH OF CENTRIFUGAL PUMP 												

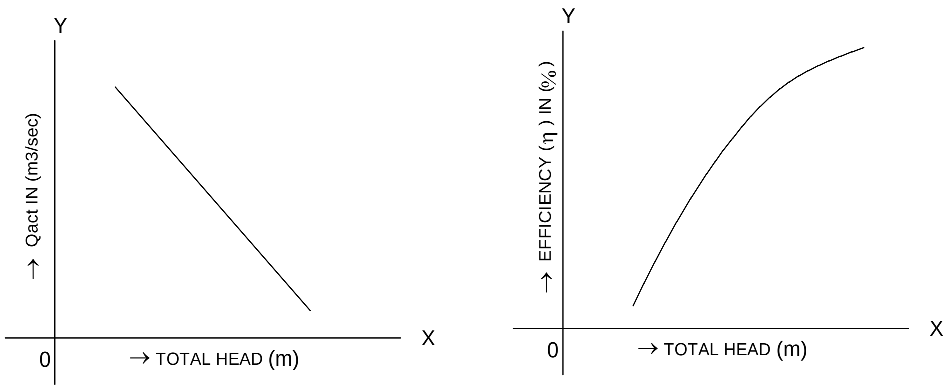
		IDEAL GRAPH OF RECIPROCATING PUMP 
11	Results & Analysis	The overall performance of centrifugal pump $\eta_{(avg)}$ = **……… (%)** The overall performance of reciprocating pump η avg = ……… (%)
12	Application Areas	Power plants
13	Remarks	
14	Faculty Signature with Date	

Experiment 07 : Performance test on a two stage Reciprocating Air compressor

-	**Experiment No.:**	1	**Marks**	15	**Date Planned**		**Date Conducted**	
1	Title	Performance test on a two stage Reciprocating Air C compressor						
2	Course Outcomes	Calculate the characteristic performance for air-compressor						
3	Aim	To determine the performance test of single stage Reciprocating pump						
4	Material / Equipment Required	Experimental setup for two stage air compressor, Stop watch.						
5	Theory, Formula, Principle, Concept	Volumetric efficiency $\eta_V = \frac{Qact}{Qthe} \times 100$ in (%)						
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Check connection and ensure direction of rotation of compressor. 9) Tabulate all the readings and calculate Isothermal efficiency. Step 2: Close shutoff valve. Step 3: Fill manometer with water. Step 4:Start the motor and observe pressure on the pressure gauge. Step 5:Once reaches 1kg/Sq. cm, adjust the valve opening for the same pressure. Step 6 Note down the reading of manometer. Step 7 Note down the time require for “n” flash of the energy meter. Step 8 Repeat the experiment for 2kg/Sq. cm, 3kg/ Sq.cm etc., Pressure.						

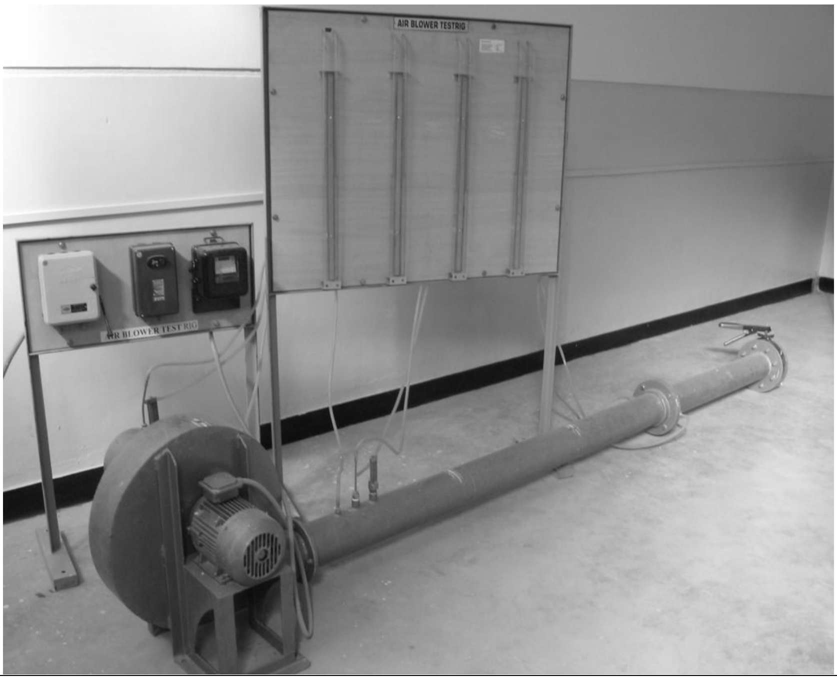
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	
8	Observation Table, Look-up Table, Output	(see table below)

Sl No.	Manometer head of water Hw = $\frac{H_1 \sim H_2}{1000}$ in m	Manometer head of air Ha = $\frac{H_w \times \rho_w}{\rho_a}$ in m	Air mass flow rate at NTP (V_1) in m3/min	Isothermal Horse power Iso Hp in KW	Input horse power IHP in KW	Isothermal efficiency η_{ISO} in (%)	Theoretical volume swept by compressor Qthe in m^3/sec	Actual volume swept by compressor Qact in m^3/sec	Free air delivered by the compressor FAD in m^3/s	Volumetric Efficiency $\eta_{vol} = \frac{Qact}{Qthe}$ in (%)

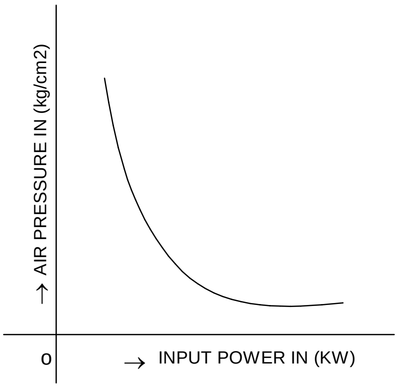
9	Sample Calculations	
10	Graphs, Outputs	IDEAL GRAPH OF RECIPROCATING PUMP 
11	Results & Analysis	The overall performance of reciprocating pump **η avg = ……… (%)**
12	Application Areas	Vehicle Air Blower testing
13	Remarks	
14	Faculty Signature with Date	

Experiment 8 : Performance test on an Air Blower

-	Experiment No.:	1	Marks	15	Date Planned		Date Conducted	
1	Title	Performance test on an Air Blower						

2	Course Outcomes	Calculate the characteristic performance for air-blower To study the performance test of a centrifugal air blower of different inlet positions
3	Aim	To study the performance test of a centrifugal air blower of different inlet positions
4	Material / Equipment Require	Air blower test rig, stop watch.
5	Theory, Formula, Principle, Concept Power	$\eta = \frac{\text{O/P Power}}{\text{I/P Power}} \times 100$ in (%)
6	Procedure, Program, Activity, Algorithm, Pseudo Code	Step 1: Connected the input power for console to 3hp AC supply with neutral and earth step 2: Keep all the switches/controls off/zero step 3: Switch on the mains and observe the light indications are ON beneath the console Step 4:Switch on the console mains ON Step 5:Switch on the instrumentation step 6:Keep the inlet valve open fully step 7:Switch on the starter so that the motor speed builds up to the constant rpm step 8: Null balance the torque arm using hand wheel step 9:take down the readings namely, blower speed ,flow, head, energy meter reading, casing pressure distribution as per the table of readings step 10:Repeat the experiment for different types of impeller and for different gate opening step 11:After the readings are taken, switch off motor and electrical mains.
7	Block, Circuit, Model Diagram, Reaction Equation, Expected Graph	**Input =** $\frac{n \times 3600 \times \eta_{motor}}{N \times T}$ in KW 
8	Observation Table, Look-up Table, Output	(see table below)

Sl NO	**Manometer Reading**			**Outlet pitot tube Reading**			**Orifice meter Reading**			**Temperature (t) in °C**		**Time taken for 5 revs of energy Meter (T) in sec**
	h_1 cm	**h_2 cm**	**H_1 m**	**h_1 cm**	**h_2 cm**	**H_2 m**	**h_1 cm**	**h_2 cm**	**hw m**	**Inlet or room temp**	**Outlet temp**	

9	Sample Calculations	$\eta = \frac{\text{O/P Power}}{\text{I/P Power}} \times 100$ in (%)
10	Graphs, Outputs	IDEAL GRAPH OF AIR BLOWER [HALF GATE OPENING] 
11	Results & Analysis	The performance test of air blower has been conducted successfully & its efficiency is found to be η_b = ………… **(%)**
12	Application Areas	Hair drier
13	Remarks	
14	Faculty Signature with Date	

F. Content to Experiment Outcomes

1. TLPA Parameters

Table 1: TLPA – Example Course

Expt-#	Course Content or Syllabus (Split module content into 2 parts which have similar concepts)	Content Teaching Hours	Blooms' Learning Levels for Content	Final Blooms' Level	Identified Action Verbs for Learning	Instruction Methods for Learning	Assessment Methods to Measure Learning
A	*B*	*C*	*D*	*E*	*F*	*G*	*H*
1	Lab layout, calibration of instruments and standards to be discussed	3	L2 (Understand)	L2 (Understand)	Conduction	Demonstrate	Viva & presentation
2	Determination of coefficient of friction of flow in a pipe.	3	L3 (Apply)	L3 (Apply)	Conduction	Demonstrate	Viva & presentation
3	Determination of minor losses in flow through pipes	3	L3 (Apply)	L3 (Apply)	Conduction	Demonstrate	Viva & presentation
4	Application of momentum equation for determination of coefficient of impact of jets on flat and curved blades	3	L3 (Apply)	L3 (Apply)	Conduction	Demonstrate	Viva & presentation
5	Calibration of flow measuring devices Orifice meter, Nozzle, Venturi meter , V-notch.	6	L3 (Apply)	L3 (Apply)	Conduction	Demonstrate	Viva & presentation
6	Performance on hydraulic Turbines	6	L3	L3	Conductio	Demonstr	Viva &

	a. Pelton wheel b. Francis Turbine c. Kaplan Turbines		(Apply)	(Apply)	n	ate	presentation
7	Performance hydraulic Pumps a. Single stage and Multi stage centrifugal pumps b. Reciprocating pump	6	L3 (Apply)	L3 (Apply)	Conduction	Demonstrate	Viva & presentation
8	Performance test on a two stage Reciprocating Air C compressor	3	L3 (Apply)	L3 (Apply)	Conduction	Demonstrate	Viva & presentation
9	Performance test on an Air Blower	3	L3 (Apply)	L3 (Apply)	Conduction	Demonstrate	Viva & presentation

2. Concepts and Outcomes:

Table 2: Concept to Outcome – Example Course

Expt - #	Learning or Outcome from study of the Content or Syllabus	Identified Concepts from Content	Final Concept	Concept Justification (What all Learning Happened from the study of Content / Syllabus. A short word for learning or outcome)	CO Components (1.Action Verb, 2.Knowledge, 3.Condition / Methodology, 4.Benchmark)	Course Outcome **Student Should be able to ...**
A	*I*	*J*	*K*	*L*	*M*	*N*
1	Determination of coefficient of friction of flow in a pipe.	friction through pipes	co-efficient of friction through pipes	To determine the coefficient of discharge of flow measuring devices.	Applying Conduction	Calculate co-efficient of friction through pipes
2	Determination of minor losses in flow through pipes	losses in pipes	different losses in pipes	To different losses in flow through pipes Applying Conduction	Applying Conduction	Calculate different losses in pipes
3	Application of momentum equation for determination of coefficient of impact of jets on flat and curved blades	impact jet on planes	impact jet on different profiles	determination of coefficient of impact of jets on flat and curved blades	Applying Conduction	Calculate impact jet on planes
4	Calibration of flow measuring devices Orifice meter, Nozzle, Venturi meter , V-notch.	discharge through flow measuring devises	Total discharge through flow measuring devises	To determine discharge through flow measuring devices	Applying Conduction	Calculate total discharge through flow measuring devices
5	Performance on hydraulic Turbines	flow pattern through the	flow pattern through the different	To Determine the energy flow pattern through the hydraulic	Applying Conduction	Calculate flow pattern through the hydraulic turbine

	a. Pelton wheel b. Francis Turbine c. Kaplan Turbines	hydraulic turbine	hydraulic turbine	turbines		
6	Performance hydraulic Pumps a. Single stage and Multi stage centrifugal pumps b. Reciprocating pump	flow pattern through the hydraulic pumps	flow pattern through the different hydraulic pumps	To Determine the energy flow pattern through the hydraulic pumps	Applying Conduction	Illustrate flow pattern through the hydraulic pumps
7	Performance test on a two stage Reciprocating Air C compressor	performance of air-compressor	characteristic performance for air-compressor	Performance test for air compressor	Applying Conduction	Calculate the characteristic performance for air-compressor
8	Performance test on an Air Blower	performance for air-blower	characteristic performance for air-blower	Performance test for air blower	Applying Conduction	Calculate the characteristic performance for air-blower