NAME OF LABORATORY : HYDRAULIC MACHINES		
LABORATORY MANUAL		
CLASS: THIRD YEAR	**PART:** I/II	**COURSE CODE :**MED 424
NAME OF COURSE : HYDRUALIC MACHINES		

INDEX

Vision:

MIT aspires to be a leader in Techno-Managerial education at national level by making students technologically **superior** and **ethically strong** having **enterprising spirit** with a **global mindset**.

Mission:

We are committed to provide wholesome education in Technology and Management to enable aspiring students to utilize their fullest potential and become professionally competent by providing:

- .Well qualified, experienced and professionally trained faculty.
- State-of-the-art infrastructural facilities and learning environment.
- Conducive environment for research and development.
- Delight to all stakeholders.

Department of Mechanical Engineering:

Vision

- "To be a centre of excellence in the field of Mechanical Engineering where the best of teaching, learning and research synergize and serve the society through innovation and excellence in teaching."

Mission

- To provide world-class under-graduate and graduate engineering education in Mechanical Engineering by imparting quality education and techno-managerial engineering training to meet the current and emerging needs of the society.

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Program Educational Objectives

1. Graduates will apply the tools and skills acquired during their undergraduate studies either in advanced studies or as employees in engineering industries.
2. Graduates of the program will have successful technical and professional career.
3. Graduates of the program will continue to learn to adopt constantly evolving technology. Graduates will demonstrate sensitivity towards societal issues

Program Outcomes

PO-1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO-2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO-3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO-4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO-5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO-6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural
issues and the consequent responsibilities relevant to the professional engineering practice.

PO-7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

PO-8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO-9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO-10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO-11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to ones own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO-12. Life-long learning: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSOs) :

PSO-I. Ability to design & analyze components & systems for mechanical performance

PSO-II. Ability to apply and solve the problems of heat power and thermal systems

PSO-III. Ability to solve the real life problems in manufacturing industries

Course Objectives

1. Understand the working of hydraulic turbines and Pumps

2. Classify the hydraulic turbines and pumps

3. Compare the performance of hydraulic turbines and pumps

4. Study of behavior of hydraulic turbines and pumps

5. To solve the problems on hydraulic turbines and pumps

Course Outcomes

At the end of course, the students will able to:

1. Explain the working of hydraulic turbines and Pumps

2. Classify the hydraulic Turbines and pumps

3. Calculate the force exerted by the jet on impeller

4. Compare the performance of turbines

5. Compare the working of hydraulic Machines

6. Analyse the performance characteristics of hydraulic machines turbines and Pumps

Dr. Babasaheb Ambedkar Marathwada University, Aurangabad

(Faculty of Science & Technology)

Syllabus Final Year B. Tech. (Mechanical Engineering) Semester-VII

Course Code: MED424 **Course: Lab – Hydraulics Machines**

Teaching Scheme: Term Work: 50 marks **Practical Examination: 50 marks**

Practical: 02 Hrs / Week **Credits: 01**

Prerequisite

1. Knowledge of fluid mechanics and machineries

Objectives:

1. To study different hydraulic machines.
2. To perform trials on turbines.
3. To perform trials on pumps.

List of Practical's (Minimum 08)

1. Assignment on 'Jet Pump and Submersible Pump'.
2. Assignment on 'Hydraulic torque convertor'.
3. Assignment on 'Hydraulic Accumulator and Hydraulic Intensifier'.
4. Assignment on 'Hydraulic Press and Hydraulic Ram'.
5. Trial on 'Pelton wheel turbine test rig'.
6. Trial on 'Francis wheel turbine test rig'.
7. Trial on 'Kaplan wheel turbine test rig'.
8. Trial on 'Centrifugal pump test rig'.
9. Trial on 'Gear pump test rig'.
10. Visit to hydro-electric power plant.

The assessment of term work shall be done based on the following.

- Continuous assessment
- Performing the experiments in the laboratory
- Oral examination conducted on the syllabus and term work mentioned above.

DO'S

- Learn objective & significance of the practical. Keep silence in the lab.
- Always perform the experiment or work presicisely as directed by course teacher
- Don't forget to bring calculator, graph sheet and other accessories when you come to Laboratory
- Before performing practical's read instrument manual carefully
- Count all accessories before receiving equipments in lab.
- Before performing practical's read instrument manual carefully.

DON'T

- Use mobile phones during lab hours.
- Don't try to repair any faulty instrument.
- Don't run machine without permission.

EXPERIMENT NO. 1

Aim: -

Study of performance characteristics of a Pelton wheel turbine at constant speed

Objectives:- 1.To determine the hydraulic efficiency of Pelton wheel

2. To determine the overall efficiency of Pelton wheel

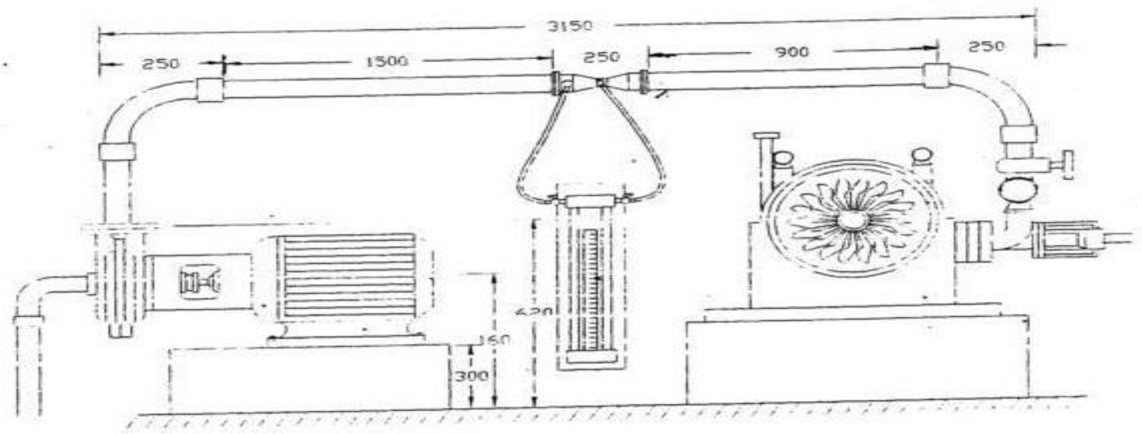
Apparatus/Equipment:- Pelton turbine test rig

Specifications of apparatus/equipment

Rated Supply Head	**38m**
Discharge	**15 lit/Sec**
Rated RPM	**500**
Power Output	**3.7kW**
Runaway Speed	**1300rpm**
Runner Diameter	**220mm**
Number of Buckets	**18**
Brake Drum Diameter	**300mm**
Rope brake diameter	**15mm**
Supply Pump set	
Discharge	**20.58LPS**
Total Head	**36m**
Power required	**15 HP, 11 kW**
Pump RPM	**2900 RPM**

Theory:- The Pelton wheel hydraulic turbine is driven by a jet of water issuing from a nozzle and striking the buckets on the wheel causing it to rotate and thus develops a power output. This creates a torque on the wheel. The flow rate of the water jet is controlled by a spear valve. After the flow leaves the turbine casing it empties into a hydraulic bench where its volume is measured along with the time using a digital timer. This will then give the volumetric flow rate through the turbine. The turbine wheel speed is measured by a digital tachometer. The torque on the turbine wheel is measured by a brake system with spring balances..

Schematic Diagram



PELTON TURBINE

Procedure:-

Procedure for constant speed:

1. Keeps the nozzle opening at the required position i.e. full opening or 3/4th opening
2. Start the pump
3. Allow water to the turbine, then the turbine rotates
4. Adjust the gate valve such that the required head is achieved.
5. Note the speed of the turbine
6. Take readings in manometer
7. Note down the pressure of water in the pressure gauge

8. Load the turbine by applying load.

9. Note down the dead weight T1

10. Note down the head.

11. Repeat the experiment for different loadings

12. Tabulate the readings

Procedure for variable speed:

1. Fix the guide vane opening as 4/8

2. Prime the pump

3. Allow water into turbine by starting the pump

4. Vent the cocks of manometer

5. Allow the water into the runner such that the speed of the turbine runner is at required constant speed using tachometer.

6. Note down the readings of left limb and right limb of differential manometer

7. Note down the pressure gauge reading

8. Note down the spring weight and dead weight on the hanger

9. Add weight to the hanger of brake drum and repeat the steps from 5 to 8.

10. Repeat the experiment steps from 5 to 10 for different guide vane openings.

Observation Table:-

<u>Constant Speed Observation</u>

1. Speed of Turbine = 550 RPM
2. Diameter of drum = 300mm
3. Diameter of rope = 15mm
4. Effective Diameter =0.315 m

Sl. No.	Load W Kg	Load W in N	Inlet Pressure P Kg/cm^2	Input Orifice meter Pressure P_1 Kg/cm^2	Output Orifice meter Pressure P_2 Kg/cm^2
1					
2					
3					
4					

Sample Calculations: - (if applicable)

1. Net Head = H= P/g*ρ

2.Discharge through orifice meter in m^3/sec $Q = \frac{c*a1*a2*\sqrt{(2.g.h)}}{\sqrt{(a12-a22)}}$

Q=k √ h where k= constant = 0.0044 and h= (P1-P2)

3. Input Power =QH in kW

Input power in kW = $\frac{\rho*g*Q*H}{1000}$

Where $=\rho * g$ =Specific weight of water = 9.81 kN/m^3

1. **Output Power =Brake power** $=\frac{2\Pi NTx9.81}{60000}$

$Efficiency = \frac{Outputx100}{Input}$ Where,

N = Turbine speed in RPM

Sample Calculations:

Results:- The over all efficiency of the turbine is ------------ %

Questions:

1. What are main components of Pelton turbine?

2. Draw velocity diagrams (at inlet and outlet) for Pelton blade

3. Why is Pelton turbine suitable for high heads?

4. What is the function of spear mechanism?

5. What is the normal range of specific speed of a Pelton Turbine?

6. What are the characteristics of Pelton wheel? What are their uses?

7. After the nozzle water has atmospheric pressure through out, then why is a casing provided to the wheel?

8. Why not Pelton wheels are suitable for high heads?

9. What are the methods available to govern the turbine?
10. Give the classification of turbines

EXPERIMENT NO. 2

Aim: -

Study of performance characteristics of a Francis turbine at constant speed

Objectives: - 1.To determine the hydraulic efficiency of Francis turbine

2. To determine the overall efficiency of Francis turbine

Apparatus/Equipment:- Francis turbine test rig, Tachometer, weights

Specifications of apparatus/equipment

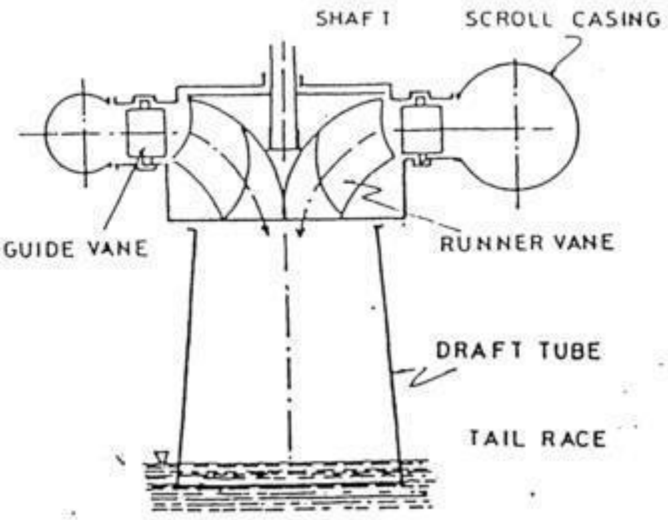
1. Rated supply head: 10 meters
2. Discharge: 1000LPM
3. Rated speed: 1250 rpm
4. Power output: 1 H.P.
5. Runway speed: 1550RPM
6. Runner diameter: 160mm
7. No. of guide vanes: 10
8. P.C.D. guide vanes : 230mm
9. Brake drum diameter: 300mm
10. Rope brake diameter: 15mm

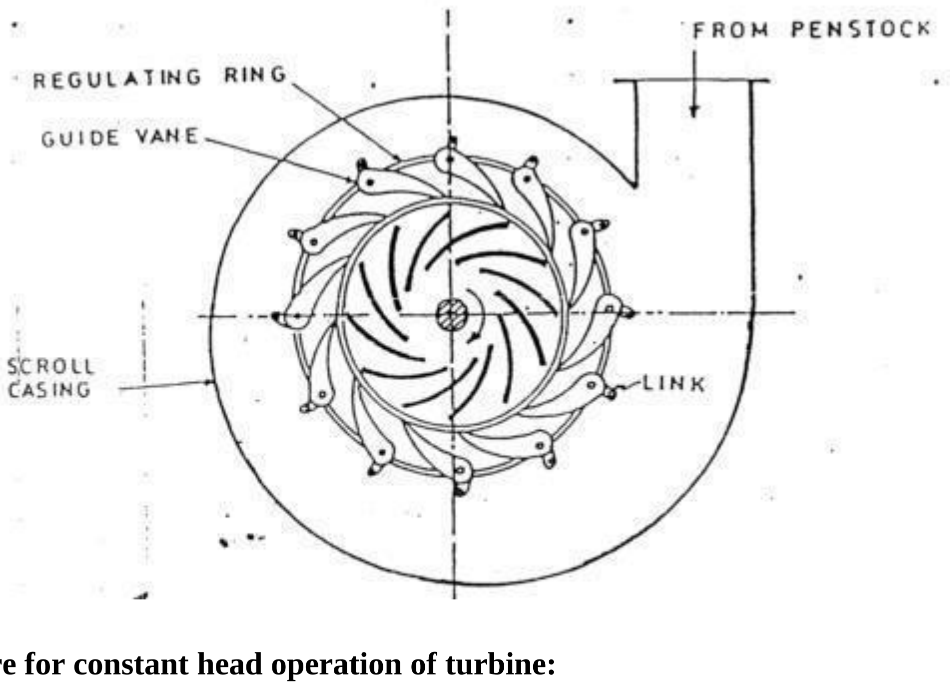
Theory:- The unit essentially consist of a spiral casing, an outer bearing pedestal and rotor assembly with runner ,shaft and brake drum, all mounted on a suitable sturdy cast iron base plate. A straight conical draft tube is provided for the purpose of regaining the kinetic energy from the exit water and also facilitating easy accessibility of the turbine due to its location at a higher level than the tail race. A transparent hollow Perspex cylinder is provided in between the draught bend and the casing for the purpose of observation flow at exit of the runner. A rope brake arrangement is provided to load the turbine. The output of the turbine can be controlled by adjusting the guide vanes for which a hand wheel and a suitable link mechanism by pressure and vacuum gauge, and for the measurement of speed, use hand tachometer.

Turbine shall be first tested at constant net supply head (at the rated value of 10m)by varying the load, speed and guide vane setting. However the net supply head on the turbine may be reduced and the turbine tested in which case the power developed by turbine and the best efficiency speed will also be reduced. Through the turbines can also be tested at higher net supply heads the supply pump set cannot develop the higher head at the same time maintaining higher of flow.

The output power from the turbine is calculated from the reading taken on the brake and the speed of the shaft. The input power supplied to the turbine is calculated from the net supply head on the turbine and discharge through the turbine. Efficiency of the turbine being the ratio between the output and input can be determined from these two readings.

The discharge is measured by the 80mm.Orificemeter and two pressure gauges. Supply head measured with the help of the pressure gauge .Use a tachometer for measuring of turbine speed





Procedure for constant head operation of turbine:

1. Fix the guide vane opening as 4/8.

2. Prime the pump

3. Allow water in the turbine by starting the pump

4. Vent the cocks of Pressure Gauges

5. Adjust the gate valve such that the sum of the pressure gauge and vacuum gauge is as required constant head.
6. Note down the pressure gauge and vacuum gauge readings.
7. Note down the spring weight and dead weight on hanger.
8. Measure the speed of the turbine using tachometer.
9. Repeat the experiment by adding loads on the brake drum
10. Repeat the steps from 1 to 10 for different guide vane opening.

Procedure for variable speed head operation of turbine:

1. Fix the guide vane opening as 4/8.
2. Prime the pump
3. Allow water into turbine by starting the pump
4. Vent the cocks of pressure gauges.
5. Allow the water into the runner such that the speed of the turbine runner is at required constant speed using tachometer.
6. Note down the pressure gauge and vacuum gauge readings.
7. Note down the spring weight and dead weight on the hanger.
8. Add weight to the hanger of brake drum repeat the steps from 5 to 8.
9. Repeat the experiment steps from 5 to 9 for different guide vane openings.

Observation Table

SR.NO	Discharge m^3/sec	Input power KW	Output power KW	Efficiency %
1				
2				
3				
4				
5				
6				
7				

CALCULATIONS:

1. Head of the water in meter

H=P×10

2. Discharge through orifice meter in m^3/sec $Q = \frac{c*a1*a2*\sqrt{(2.g.h)}}{\sqrt{(a12-a22)}}$

Q=k √ h

Where,

a_1=Area of the pipe at inlet in m^2.-0.005026m^2 (d_1=80mm)

a_2=Area of orifice meter in m^2.0.002687m^2 (d_2=58.5mm)

C=co-efficient of orifice meter (cd=0.65)

h=Head of water in meter (P_1-P_2)

K=9.15*10^{-3}

3. **Input power in kW=** $\frac{\rho*g*Q*H}{1000}$

Where,

ρ=1000Kg/m^3

g=9.81m^2/sec

Q=Discharge through orifice meter in m^3/sec

H=Head of water(P)

4.Output power in KW

OP=-$\frac{2.\pi.N.T*9.81}{60*1000}$

Where,

Torque=T=W*Re

Re=0.165m

Brake Drum net load W=(W_1+ weight of rope &hanger)-W_2 kg

5).Overall Efficiency η% =$\frac{OUTPUTPOWER*100}{INPUTPOWER}$

RESULTS : - The over all efficiency of the Francis turbine is ------------ %

Review Questions:

1. What is the function of draft tube?

2. What is the function of guide vanes?

3. Can you locate the portion in Francis turbine where cavitations likely to occur?

4. What is the advantage of draft tube divergent over a cylindrical of uniform diameter along its length?

5. What are fast, medium by slow runners?

EXPERIMENT NO. 3

Aim: -

Study of performance characteristics of a of Kaplan turbine at constant speed

Objectives:- 1.To determine the hydraulic efficiency of Kaplan turbine

2. To determine the overall efficiency of Kaplan turbine

Apparatus/Equipment:- Kaplan turbine test rig, Tachometer,

Specifications of apparatus/equipment

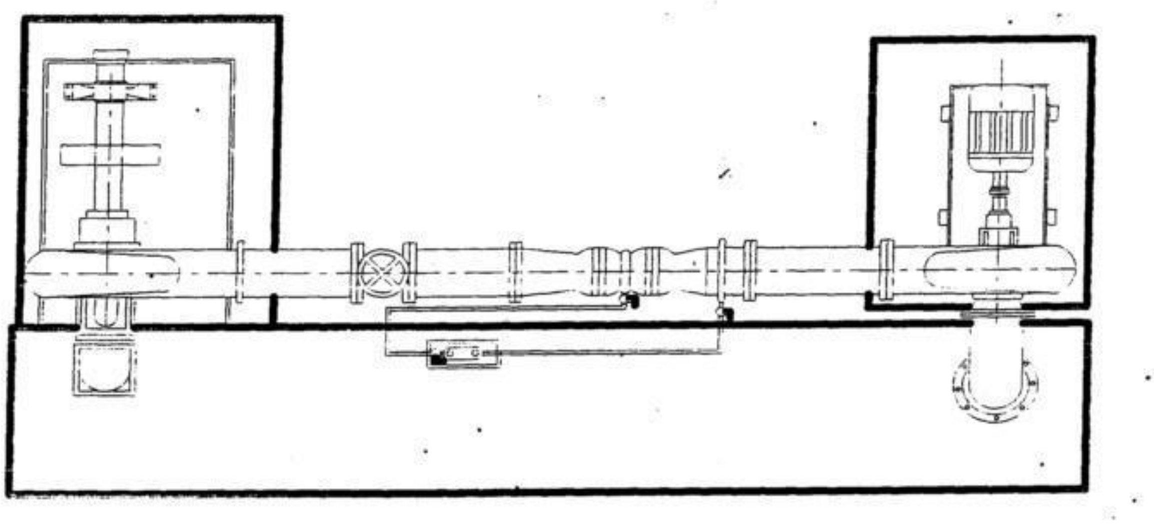
Power Output	1 HP
Run away speed	1500RPM
Runner outside dia	200mm
Hub diameter	110mm
Hub Ratio	0.55
No. of guides vanes	16
P.C.D. guide vanes	230mm
Brake down dia	300mm
Rope brake dia	15mm
Supply Pump set	
Power Output	9m
Discharge	47lps
Normal speed	1440 RPM

CONSTRUCTIONAL SPECIFICATION SPRAL CASING

It is close grained case iron with flanges inlet, designed for constant velocity water distribution.

RUNNER :

Is of Stainless with four aero – foil blades, designed to the latest hydrodynamic principles. All parts comes in contact with water are made up of bronze or stainless steel to prevent corrosion



KAPLAN TURBINE

GUIDE VANE MECHANISM

Consists of bronze vanes cast integral with their spindles. By suitable external link mechanism these can be set at different relative positions, and two external dummy guide vanes are provided to indicate the exact position in the actual guide vanes working inside the turbine, thus showing the relative water passages through the guide apparatus for the different position of the guide vanes.

SHAFT: Is of heavy duty type designed for long life. One double row deep groove rigid ball bearing to take care of radial loads and a thrust ball bearing to take the axial thrust and self weight of the rotor assembly are provided in the bearing bracket. A self aligning type ball bearing is used in the bearing pedestal for trouble free operation.

2. TESTING

Water turbines are tested in the hydraulic laboratory to demonstrate how tests on small water turbine are carried out to study their construction and to give the students a clear knowledge about the different types of turbines and their characteristics. The output power form the turbine calculated from the reading taken on the brake drum and the speed of the shaft. The input power supplied to the turbine is calculated from the net supply head on the turbine and discharge through the turbine. Efficiency of the turbine being ratio between the output and the input can be determined from these two readings. The discharge is measured by the 150mm orifice meter and its the pressure gauges. The supply head is measured with the help of pressure and vacuum gauges. The speed of the turbine is measured with a digital tachometer.

Procedure:

1. Keep the guide vane at 2/8 opening
2. Keep the runner vane at 3/8 opening
3. Prime the pump and close the gate valve
4. Start the pump
5. Open the gate valve slowly
6. Note down the pressure gauge reading G.
7. Note down the vacuum gauge reading V.
8. Vent the gauges of Orificemeter
9. Note down the readings of pressure gauge (G1) and vacuum gauge (V1)
10. Measure the speed of the turbine by tachometer.
11. Load the turbine by placing dead weight and take all readings.
12. Experiment can be repeated for different guide and runner vane openings.

OBSERVATION TABLE

No.	W_1 Kg	W_2 Kg	P Kg/cm^2	P_1 Kg/cm^2	P_2 Kg/cm$_2$	Speed (R.P.M.)
1						
2						
3						
4						

IMPORTANT FORMULA

Input Power = QH in kW

Input power in kW = $\frac{\rho * g * Q * H}{1000}$

Where = Specific weight of water = 9.81 kN/m^3

Q = Discharge in m^3 / sec.

$$Q = \frac{c * a1 * a2 * \sqrt{(2.g.h)}}{\sqrt{(a12 - a22)}}$$

H = Supply head in meters

Output Power =Brake power $= \frac{2\Pi NTx9.81}{60000}$

$$Efficiency = \frac{Outputx100}{Input}$$

Where,

N = Turbine speed in RPM

T = Torque in kgm, (effective radius of the brake drum in meters

T=(R) x The net brake drum load

R_e = 0.165m

RESULTS: The over all efficiency of the Kaplan turbine is ------------ %

Review Questions:

1. What are suitable conditions for erection of Kaplan Turbine?

2. Why is the number of blades of Kaplan turbine restricted to 4 to 6?

3. Is this turbine axial flow or mixed flow?

4. Port load efficiency of Kaplan turbine is high, why?

5. What is the minimum pressure that can be maintained at the exit of the reaction turbine?

EXPERIMENT NO. 4

Aim: - To determine the efficiency Centrifugal Pump

Objectives: - To conduct a trial on the centrifugal pump

Apparatus/Equipment: - Centrifugal Pump**,** Stop watch, measuring scale and Energy meter etc.

Specifications of apparatus/equipment

Supply tank :- 1210 x 500 x 500mm

Measuring tank: - 500 x 450 x 450mm

Suction pipe :- with vacuum gauge.

Delivery pipe :- With gate valve & pressure gauge.

Theory:-

A pump may defined as a machine, which when driven from an external source lifts water or any other liquid from a lower level to a higher level, It may also be defined as a machine which converts mechanical energy into pressure energy.

A centrifugal pump raises water from lower level to a higher level involving the action of centrifugal force. It also increases the pressure energy of fluids. Pumps are used to supply water for domestic, industrial & irrigation purposes.

CENTRIFUGAL PUMP:-

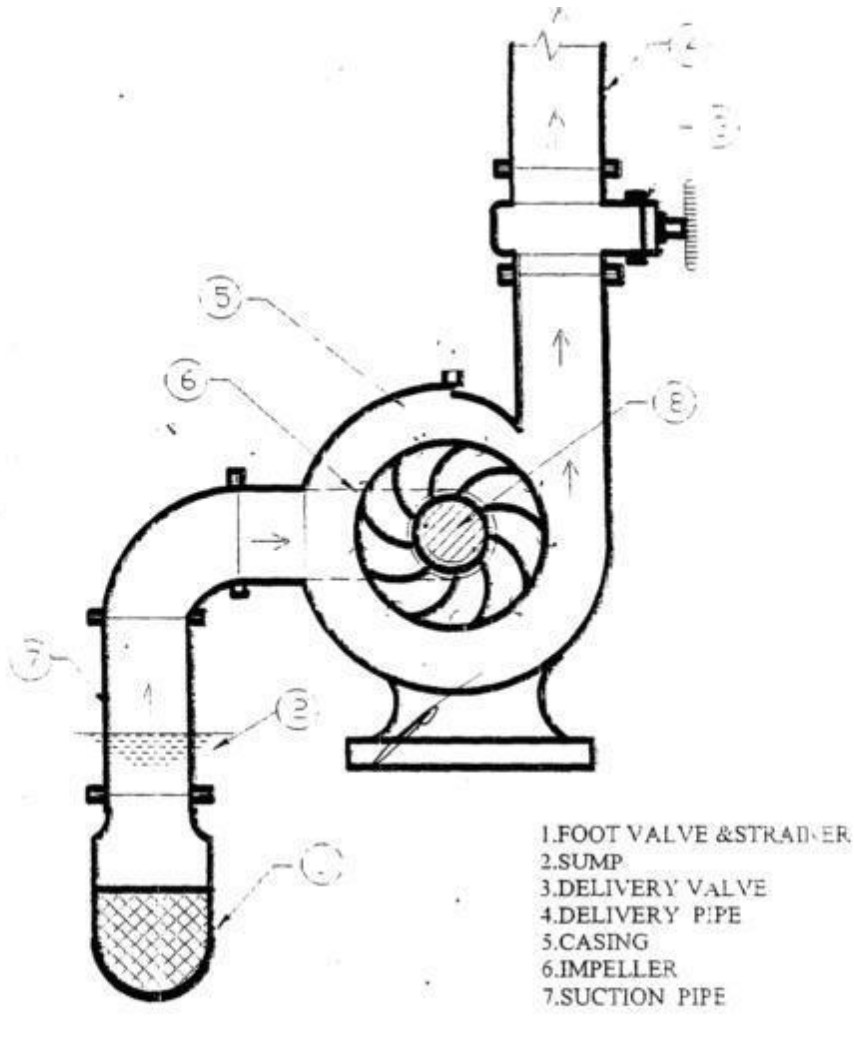
The centrifugal pump is contrivance to raise liquid from a lower to higher level by creating the required pressure with the help of centrifugal action .in general it can by creating the required pressure with help of centrifugal action. In general it can be defined as a machine which increase the pressure energy of a fluid, as a pump may not be used to lift water at all , but just to boost the pressure in a pipeline. Whirling motion is imparted to the liquid by means of backward curved blades mounted on a wheel known as impellers.

It will be interesting to know that the action of a centrifugal pump is that of a reversed reaction turbine. In a reaction turbine, the water at high pressure, is allowed to enter the casing which gives out mechanical energy at its shaft, where as in pump, the mechanical energy is fed into the outgoing fluid. The water enters the impeller radially & leaves the vans axially.

WORKING PRINCIPLE OF A CENTRIFUGAL PUMP:-

A centrifugal pump is a device to raise the liquid from a lower level to higher level. The pressure head is developed by centrifugal action which in turn is entirely due to the velocity imparted to the liquid by the rotating impeller & not due to any displacement of impact. The action of a centrifugal pump is that of a reversed reaction turbine. In fact this is reverse of Francis turbine. However in the former, special arrangement are made to increase the efficiency. The action of a centrifugal pump is that of a reversed reaction turbine. In fact this is reverse of a Francis turbine. However in the former, special arrangement are made to increase the efficiency. The centrifugal works under roto-dynamic action, the pressure head developed by centrifugal action. The pump must be full when starting. It given by power from an external source as a result of which the vanes are rotated. This imparts a centrifugal head to the water in the pump & water leaves the vanes at the other circumference with high velocity & pressure. This creates a partial vacuum in the centre into which the water from the suction pipe rushes. The high pressure from the leaving water is utilized in overcoming the delivery head of the pump. A centrifugal pump is also called as a roto dynamics pump. In this pump the pressure is generated dynamically & continuously by the circular motion of a wheel carrying some vanes, which are curved backward or forward or in radial direction. Hence the pump is known as roto-dynamic pump.

Schematic Diagram



Procedure:-

1. Prime the pump with water
2. Start the motor
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 100mm of water level in measuring tank

4. Very the position of gate valve in delivery pipe.
5. Repeat the above procedure for different discharges.

OBSERVATIONS:-

1. Difference of height between two gauges = 0.665 m
2. Energy meter constant = 6400 imp/ kWh.
3. Transmission efficiency = 80 %.
4. No. of flash of energy meter = 10flash.
5. Area of measuring tank = (0.50 x 0.45) m^2m^2
6. RPM of pump = 2900.
7. Speed of motor = 3000 R.P.M. variable

OBSERVATION TABLE:-

Sr.No.	Suction Head(Hs)	Delivery Head(Hd)	Total Head H=(Hs+Hd) +0.665	Time required for 10 flash In sec.	Time required for Rise of water Level In Measuring Tank In sec.
	M.M. Of Hg	M. of H_2O	Kg/cm^2	sec	
1					
2					

3					
4					
5					
6					
7					

CALCULATIONS:-

1) 1m.of Hg =13.6 M. OF H_2O (hs x13.6 /1000) Meter of water
2) hd = P x 10 Meter of water Column
3) H= -hs + hd + 0.66 (Total Head)

4) Input power = IP = $\frac{3600*N*Transmissionefficiency}{C*T}$

N= No. of flash counted =10

C= Meter constant =6400

T= Time in seconds.

5) Output power = OP =$\frac{\rho.gQ.H}{1000}$

H = total head in m.

ρ = Density of water -1000Kg/m^3

Q = Discharge in m3/sec. g= 9.81m/s^2

Q = $\frac{Areaoftank\in m^2 x0.1m.}{Timerequired\in sec}$

5).Overall Efficiency η% =$\frac{OUTPUTPOWER*100}{INPUTPOWER}$

RESULTS:-

Overall efficiency of Centrifugal Pump is ------------- %

Review Questions:

1. What is priming? What is use of foot valve?
2. What is manometric head?
3. What is the function of the casing used in centrifugal pump?
4. What is NPSH?
5. What is the minimum starting speed of a centrifugal pump?
6. Hydraulic efficiency of centrifugal pump is defined as.
7. The centrifugal pump should be so installed above the water level in the sump why?

EXPERIMENT NO. 5

Objective: To conduct a trial on the gear pump

Aim: To determine the efficiency of Gear Pump

TEST SET UP : - It comprises following

1) Gear pump with motor.
2) Electrical panel.
3) Accessories

THEORY:

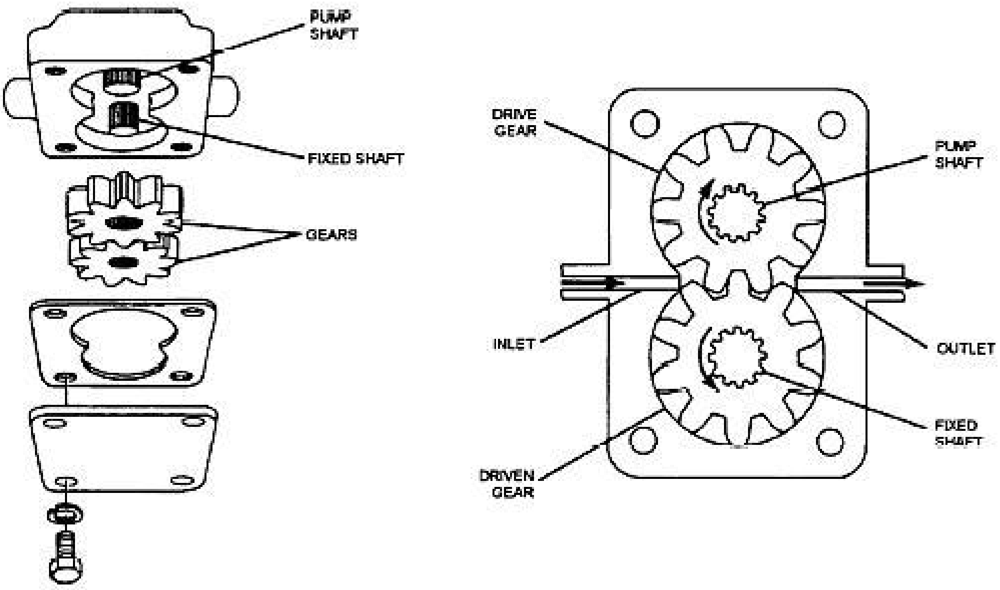
A Gear pump raises oil from lower level to a higher level involving the action of mechanical force. It also increases the pressure energy of fluids. Pumps are used to supply water for domestic, industrial & irrigation purposes.

The Gear pump is contrivance to raise liquid from a lower to higher level by creating the required pressure with the help of gear action .in general it can by creating the required pressure with help of mechanical action. In general it can be defined as a machine which increase the pressure energy of a fluid, as a pump may not be used to lift oil at all , but just to boost the pressure in a pipeline. Whirling motion is imparted to the liquid by means of gear mounted on a shaft .As liquid enters pump due to mechanical action of rotating gear mounted on the central shaft pressure of liquid increases. Gear rotates with the help of motor

WORKING PRINCIPLE OF GEAR PUMP:-

A gear pump is a device to raise the liquid from a lower level to higher level.The pressure head is developed by mechanical action of gear which in turn is entirely due to the velocity imparted to the The pump must be full when starting. It given by power from an external source as a result of which the gears are rotated. This imparts a mechanical energy to the oil in the pump &oil leaves the gears at the other circumference with high velocity &

pressure. This creates a partial vacuum in the centre into which the water from the suction pipe rushes. The high pressure from the leaving water is utilized in overcoming the delivery head of the pump.



GEARPUMP

EXPERIMENTAL SETUP:-

SUPPLY TANK :- 450 x450 x 700mm

MEASURING TANK: - 450 x 550 x 400 mm

SUCTION PIPE :-with vacuum gauge.

DELIVERY PIPE :-with gate valve & pressure gauge.

PROCEDURE:-

1. Check the gear pump height is at liquid level and start the motor.
2. Start the motor
3. Note down the following readings.
   a) Vacuum gauge reading.

b) Pressure gauge reading

c) Time required for 10 flesh of energy meter.

d) Time required for 100mm of water level in measuring tank

4. Very the position of gate valve in delivery pipe.
5. Repeat the above procedure for different discharges.

OBSERVATIONS:-

1. Difference of height between two gauges = 1.115 m
2. Energy meter constant = 6400 imp/kWh.
3. Transmission efficiency = 80 %.
4. No. of flash of energy meter = 10flash.
5. Area of measuring tank = (0.25 x 0.45) m^2
6. R.P.M OF PUMP = 1440.

OBSERVATION TABLE:-

Sr.No.	Suction Head(Hs)	Delivery Head(Hd)	Total Head H=(Hs+Hd) +1.115	Time required for 10 flash in sec.	Time required for Rise of oil Level In Measuring Tank In sec.
	M.M. Of Hg	M. of oil	Kg/cm^2	M.of oil	
1					
2					

3					

CALCULATIONS:-

1) Delivery Head (Hd)
   P=Hd*g*ρ

2) Suction Head (Hs)
   Hs= H*13.6
   H= Reading Of vacuum gauge

4) Input power = IP = $\frac{3600*N*Transmissionefficiency}{C*T}$

N= No. of flash counted =10

C= Meter constant =6400

T= Time in seconds.

5) Output power = OP =$\frac{\rho.gQ.H}{1000}$

H = total head in m.

ρ = Density of water -917.4 Kg/m^3

Q = Discharge in m3/ sac. g= 9.81m/s^2

Q = $\frac{Areaoftank \in m^2 x0.1m.}{Timerequired \in sec}$

5).Overall Efficiency η% =$\frac{OUTPUTPOWER*100}{INPUTPOWER}$

RESULTS: Over all efficiency of gear pump is -----------%

Review Questions:

1. What will happen if I put Gear Oil instead of engine oil in a generator engine?
2. What are the applications of gear oil pump?
3. What are the types of gear pumps?