



## **FLUID MECHANICS LABORATORY**

### **AIM:**

To perform experiments on various types of pumps and turbines to understand their characteristics and Impart an insight into working of various fluid machines and be able to compare performance of fluid machines under different working conditions.

### **OBJECTIVES:**

- To understand the concepts flow through different cross sections.
- To understand and draw characteristics of various pumps and performance characteristics of different turbines

### **LIST OF EXPERIMENTS:**

#### **1. FLOW MEASUREMENT**

Calibration of Flow Measuring instruments – venturimeter, orifice meter, rotometer, Calibration of flows in open channels – weirs and notches. Estimation of friction factor in flow through pipes.

#### **2. PUMPS**

Determination of performance characteristics of pumps – centrifugal pumps, submersible pumps, turbine pumps and positive displacement pumps – reciprocating and gear pumps.

#### **3. TURBINES**

Determination of performance characteristics of turbines – reaction turbines and impulse turbines.

### **LIST OF EQUIPMENTS:**

1. Flow Measurement Apparatus
2. Centrifugal Pump
3. Reciprocating Pump
4. Gear Pump
5. Submersible Pump Test Rig
6. Pelton Wheel Turbine
7. Kaplan Turbine
8. Francis Turbine

## AATFM01 FLOW MEASUREMENT APPARATUS

AATFM01 Venturimeter & Orifice meter is a device used to measure the flow in a pipe line. Venturimeter has converging & diverging section while Orifice meter is made up of thin circular plate & has a hole then a convergent section.

### Description :

The equipment consist of Venturimeter & Orifice meter fitted in two different pipe lines & connected to a manifold. The tapping on Venturi & Orifice are connected to a differential manometer. A measuring tank is supplied to measure discharge. A rotameter is used to find cd.

### Utilities Required :

- Electric supply 0.5 kW, 220V AC, Single Phase
- Water supply Tap water connection " BSP Distilled water @ 60 liters (optional)
- Floor Area with Drain facility

### TECHNICAL DETAILS:

#### Specifications:

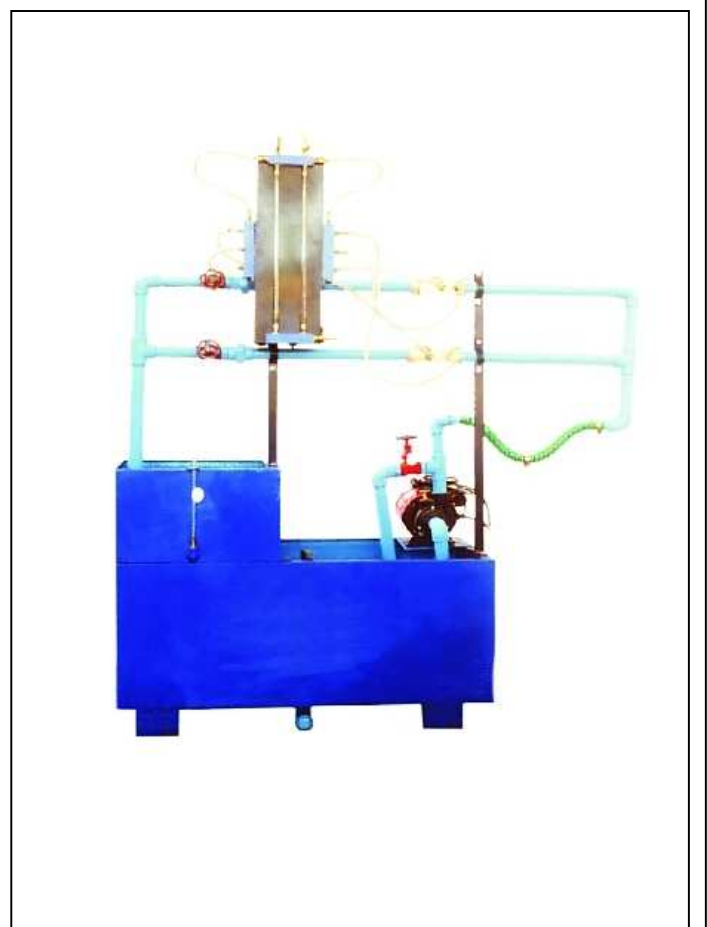
- Sump tank with flow: 1200 mm x 600mm x 300 mm
- Measuring tank: 400 mm x 600 mm x 250 mm
- Mercury Manometers (Differential)
- Each line provided with flow control valve for setting of different flow rates.
- Pressure tubes of different pipe lines are connected to common manometer through cocks.
- Easy to operate and replacement of Venturimeter & Orifice meter.
- Flow control valve at the end of each line assures full running of pipe.

#### Features :

- Rust proof powder coating to the tank.
- Mercury Manometer for Reading.
- 1/2 hp Motor operation.

#### Range of Experiments :

- To determine the co-efficient of discharged through Venturimeter and orifice meter.
- To measure discharge through Venturimeter and Orificemeter as flow meters.



## AATFM02 CENTRIFUGAL PUMP

AATFM02 is designed to study the performance of centrifugal pump. Set up consists of a centrifugal pump coupled with electrical motor, supply tank, measuring tank & pipe fittings for closed loop water circulation. Pressure and Vacuum gauges are connected on delivery and suction side of pump for the purpose of measurement. The flow rate of water is measured using measuring tank and stop watch.

### Utilities Required :

- **Electric supply :**
  - Provide 230 +/- 10 VAC, 50 Hz, single phase electric supply with proper earthing. (Neutral – Earth voltage less than 5v AC.)
  - 5A, three pin socket with switch for pump.
- **Water supply :**
  - Tap water connection BSP & Distilled water @ 180 liters (optional)
- **Floor space of 1 m. x 1 m.**

### TECHNICAL DETAILS:

- Centrifugal pump:
  - Size : 1” x 1”
  - Variable speed Type
  - Capacity : 1hp
- D. C. motor & speed controller.
- Sump tank: 1000 X 400 X 400 mm.
- Measuring Tank: 400 X 400 X 400 mm.
- Energy meter for motor input measurement.
- Pressure & vacuum gauge for measurement of head.
- Stop watch.
- The assembly of pump & control are mounted on the sump tank.

### Range of Experiments:

- To find out efficiency of a centrifugal pump test rig at various speeds.
- To determine overall efficiency and pump efficiency of the centrifugal pump.
- To plot Head vs. Discharge, Pump efficiency vs. Discharge



Component	Specifications
Sump Tank(MS & Composites)	1000 X 400 X 400
supply pump(centrifugal pump)	1HP
collecting tank(MS & Composites)	400 X 400 X 400
Flow control valve	Gate valve
Drain valve	cock type
Voltmeter	0-1000V
Ammeter	0-10amp

## AATFM03 RECIPROCATING PUMP

AATFM03 is designed to study the performance of reciprocating pump. It consists of a reciprocating pump coupled with electrical motor, supply tank, measuring tank & pipe fittings for closed loop water circulation. Pressure and Vacuum gauges are connected on delivery and suction side of pump for the purpose of measurement.

- The flow rate of water is measured using measuring tank and stop watch

### UTILITIES REQUIRED:

- Floor space of 3 m x 3 m.
- 230 V, 15 A, 1 pH A.C. electric supply with earthing connection.

### TECHNICAL DETAILS:

#### Specifications :

- Sump Tank is made from Mild steel / Composites and of standard dimensions (600 X 400 X 400 mm ).
- The Supply Pump is a Reciprocating pump with a capacity of 1hp.
- Collecting Tank is made from Mild Steel / Composites.
- Flow control valve - Gate valve.
- Drain valve - Cock type.
- Voltmeter : 0 - 1000v
- Ammeter : 0 - 10amp
- Equipped with Digital Energy Meter.

#### Range of Experiments :

- To find out efficiency of reciprocating pump at Different discharges.
- To determine overall efficiency and pump efficiency of the reciprocating pump.
- To plot Head vs. Discharge, Pump efficiency vs. Discharge



## AATFM04 GEAR PUMP

AATFM04 is designed to study the performance of gear pump. It consists of a gear pump having a pair of meshed gears coupled with electrical motor, supply tank, measuring tank & pipe fittings for closed loop oil circulation. Pressure and Vacuum gauges are connected on delivery and suction side of pump for the purpose of measurement. The flow rate of water is measured using measuring tank and stop watch.

### UTILITIES REQUIRED:

- Floor space of about 1.5 x 1.5 m.
- 4440V, 1 SA, A three phase AC electric supply with earthing connection.
- Oil supply - Quantity : 30 liters

### TECHNICAL DETAILS:

#### Specifications :

- Sump Tank is made from Mild steel / Composites and of standard dimensions(600 X 400 X 400 mm ).
- The Supply Pump is a Gear pump with a capacity of 1hp.
- Collecting Tank is made from Mild Steel / Composites.
- Pressure gauge for discharge head.
- Flow control valve - Gate valve.
- Drain valve - Cock type.
- Needle valve to control discharge pressure.
- Pressure relief valve in discharge pipe.
- Voltmeter : 0 - 1000v
- Ammeter : 0 - 10amp
- Equipped with Digital Energy Meter for Power Input.
- Discharge measurement tank.

#### Range of Experiments :

- To determine overall efficiency and pump efficiency of the gear pump.
- To plot Head vs. Discharge, Pump efficiency vs. Discharge



## AATFM05 SUBMERSIBLE PUMP TEST RIG

AATFM05 is designed to study the performance of submersible pump. It consists of a submersible pump coupled with electrical motor, supply tank, measuring tank & pipe fittings for closed loop oil circulation. Pressure and Vacuum gauges are connected on delivery and suction side of pump for the purpose of measurement.

The flow rate of water is measured using measuring tank and stop watch. A gate valve is provided at the discharge which facilitates estimation of pump performance at various discharge heads.

### UTILITIES REQUIRED:

- Floor space of about 3 x 3 m.
- 230v, A three phase AC electric supply with earthing connection.
- Oil supply - Quantity : 30 liters

### TECHNICAL DETAILS:

#### Specifications :

- Deep well Multistage submersible pump : Size- 40mm.
- Motor Capacity – 1.5 hp
- Equipped with DOL Starter
- Energy meter for the measurement of power input.
- Piping system consisting of pipes, valves and fittings with pressure and vacuum gauges.
- 50mm Orifice meter and a mercury differential manometer for discharge measurement.
- The assembly of pump & control are mounted on the sump tank.

#### Range of Experiments :

- To find out efficiency of Submersible pump at Different discharges.
- To determine overall efficiency and pump efficiency of the submersible pump.
- To plot Head vs. Discharge, Pump efficiency vs. Discharge





## AATFM06 PELTON WHEEL TURBINE (CLOSED CIRCUIT)

AATFM06 Apparatus consists of a small Pelton wheel connected to a rope brake. Water is supplied to the turbine by a centrifugal pump. Water flow is measured by a venturi meter and a mercury manometer. Water jet is directed over the buckets by a nozzle & a spear operating inside the nozzle controls the water flow. Thus the students can visualize the operation & estimate B. H. P. & W. H. P. and various efficiencies of Pelton Turbine.

### UTILITIES REQUIRED:

- Water Supply and Drain
- Three Phase Electricity, 1.5 kW, 440V AC
- Floor Area 1.5 x 0.75 m

### TECHNICAL DETAILS:

- Pelton Wheel :
  - Type : Impulse Turbine
  - Fitted with 18 buckets
  - Nozzle for water jet
  - Spear arrangement and casing with one side of Perspex sheet.
- Supply pump :
  - Capacity - 15 hp.
  - Monoblock
- Venturi of 65 mm with mercury manometer to measure water flow rate.
- Pressure gauges : 0-100psi
- Flow control valve - Gate valve.
- Drain valve - Cock type.
- Equipped with Rope brake arrangement with spring balances.
- The unit is recirculating type with all the components mounted over the sump tank

### Range of Experiments:

- To study the operation of a Pelton Wheel Turbine
- To determine the Output Power & the Efficiency of Pelton Wheel Turbine.



## AATFM07 KAPLAN TURBINE (CLOSED CIRCUIT)

Kaplan Turbine (AATFM07) is an axial flow reaction turbine and is suitable for low head. The power produced by a turbine is proportional to  $QH$ . As the head ( $H$ ) decreases the discharge ( $Q$ ) must increase to produce the same power. The present set-up consists of a scroll casing housing a runner. Water enters the turbine through the stationary guide vanes and passes through the runner axially. The runner has a hub and airfoil vanes, which are mounted on it.

The set-up is complete with guide mechanism. Pressure and Vacuum gauges are fitted at the inlet and outlet of the turbine to measure the total supply head on the turbine.

### UTILITIES REQUIRED:

- Water Supply and Drain
- Electricity 1.5 kW, 440V AC, Three Phase
- Floor Area 1.5 x 0.75 m

### TECHNICAL DETAILS:

- Kaplan Turbine
  - Type : Axial Reaction Turbine
  - Rated Capacity : 5 hp
  - Rated Speed : 1500 rpm
  - Discharge Capacity : 4500 ltrs/min.
  - Guide Vanes are made of Gun Metal.
- Supply Pump set
  - Capacity : 15 hp
  - Starter : Star Delta Crompton Make
- Pressure gauges : 0-100psi (Analog/ Digital)
- Flow control valve - Gate valve.
- Drain valve - Cock type.
- Equipped with Digital RPM Indicator
- Sump Tank
  - Material : M.S Powder Coating/ M.S.FRP Lining/ S.S Unit.

### Range of Experiments :

- To study the operation of Kaplan turbine.
- To determine the Output Power of Kaplan Turbine.
- To determine the turbine efficiency





## AATFM08 FRANCIS TURBINE

Francis Turbine (AATFM08) is a reaction turbine. The water enters the turbine through the outer periphery of the runner in the radial direction and leaves the runner in axial direction and hence it is called a mixed flow turbine.

- The present set-up consists of a runner. The water is fed to the turbine by Means of Centrifugal Pump, radially to the runner. The runner is directly mounted on one end of a central SS shaft and other end is connected to a brake arrangement
- Pressure and Vacuum gauges are fitted at the inlet and outlet of the turbine to measure the total supply head on the turbine.

### Utilities Required :

- Water Supply and Drain
- Electricity 15 kW, 440V AC, Three Phase
- Floor Area 1.5 x 0.75 m

### TECHNICAL DETAILS:

- Turbine capacity: 1.5 hp
- Turbine rotor: Gun metal casted
- Pump- motor capacity: 5 hp kirloskar make
- Loading : Mechanical rope brake/electrical generator loading
- Closed circuit with stainless steel tanks
- Flow measurement by Notch/venturi meter
- Starter, RPM indicator, pressure gauge with accessories.

### Range of Experiments :

- To study the operation of a Francis Turbine
- To determine the Output Power of Francis Turbine
- To determine the Turbine Efficiency

