EXPERIMENT NO 6

Aim: - To study the constructional details of a centrifugal pump and draw its characteristics curve.

Apparatus used: - Centrifugal pump test rig.

Theory: - The hydraulic machine which converts the mechanical energy in to pressure energy by means of centrifugal force acting on the fluid is called centrifugal pump.

The centrifugal pump acts as a reverse of an inward radial flow reaction turbine. This means that the flow in centrifugal pump is in the radial outward directions. The centrifugal pump works on the principle of forced vertex flow which means that when a certain mass of liquid is related by an external torque, the rise in pressure head of the rotating liquid takes place. The rise in pressure head at any point of the rotating liquid is proportional to the square of the tangential velocity of the liquid at that point. Thus at the outlet of the impeller radius is more, the rise in pressure head will be more and the liquid will be discharged at the outlet with a high pressure head. Due to this pressure head, the liquid can be lifted to a high level.

Constructional details:-

Main part of a centrifugal pump:-

1. Impeller:-The rotating part of a centrifugal pump is called "Impeller". It consists of a series of backward curved vanes. The impeller is mounted on a shaft which is connected to the shaft of an electric motor.

2. Casing: - The casing of a centrifugal pump is similar to the casing of a reaction turbine. It is an air-tight passage surrounding the impeller and is designed in such a way that the kinetic energy of the water discharged at the outlet of the impeller is converted in to pressure energy before the water leaves the casing and enters the delivery pipe. The following three types of casing are commonly adopted:-

(i) Volute casing
(ii) Vortex casing
(iii) Casing with guide blade

2. Suction pipe with a foot-valve and a strainer: - A pipe whose one end is connected to the inlet of the pump and other end dips in to water in a sump is known as suction pipe. A foot valve which is a non-return valve or one way valve is fitted at the lower end of the suction pipe. The foot valve opens only in

the upward direction. A strainer is also fitted at the lower end of the suction pipe.

3. Delivery pipe: - A pipe whose one end is connected to the outlet of the pump and other end delivers the water at a required height is known as delivery pipe.

Formulae used:-

Inlet pressure head = P_1m

Discharge pressure head = P_2m

Flow rate = Qm^3/s

In centrifugal pump, we take

Manometer head H = Total head at inlet- Total head at outlet

Datum head = Z_2m

Total head across pump H = $(P_1-P_2)+Z_2$

Torque 'T' = (load. arm distance)

Input power P = (2π. speed in r.p.s. T) Watts

Water power Po = (ρ. g. H .Q) Watts

Efficiency $\acute{\eta}$ % = Water power /Input power .100s

Observation table:-

Position of delivery pressure gauge (datum head) = Z_2m

Arm distance = m

ρg = 9810

Area of collecting tank, a = cm^2

Sl no	Discharge measurement			Discharge Q m^3/s	Pump speed r.p.s	Suction head m	Delivery head m	Manometric head m	Load kg	Torque Kg m	Water power w	Input power w	η %
	Initial h_1 m	Final h_2 m	Time s										

Procedure:-

1. Note down the area of collecting tank, position of delivery pressure gauge and arm distance of the spring from the centre of shaft.
2. Priming the pump set before starting.
3. The speed control on the motor is set to a value and at the same time the flow regulating valve was adjusted to give the maximum possible discharge.
4. Conditions were allowed to steady before the rate of discharge Q, suction head, load on the motor and r.p.s. value were recorded.
5. The flow rate is reduced in stages and the above procedure is repeated.
6. The procedure is repeated other type of values.

Result:-

Viva Questions:-

1. What is pump?
2. The centrifugal pump is works on which principle?