PUMPS AND FILTERS IN IRRIGATION

1. Introduction to Irrigation Pumps

An irrigation pump is a mechanical device used to lift water from a water source and supply it to agricultural fields through irrigation systems. Pumps are essential for lifting groundwater from wells and borewells and conveying surface water from rivers, ponds, canals and reservoirs.

Pumps provide the required pressure and discharge for different irrigation methods, such as surface, sprinkler and drip irrigation.

2. Functions of Irrigation Pumps

1. To lift water from wells, borewells and rivers.
2. To supply water to agricultural fields.
3. To maintain the required pressure in irrigation pipelines.
4. To operate sprinkler irrigation systems.
5. To supply water for drip irrigation systems.
6. To transfer water between storage tanks and reservoirs.
7. To provide drainage and remove excess water from fields.

3. Classification of Irrigation Pumps

Pumps used in irrigation are classified into the following categories.

A. Centrifugal Pumps

A centrifugal pump uses centrifugal force to move water from a lower level to a higher level. It consists of a rotating impeller enclosed within a casing.

Applications:

- Surface irrigation.
- Sprinkler irrigation.
- Drip irrigation.
- Water supply from ponds and canals.

B. Reciprocating Pumps

A reciprocating pump operates through the back-and-forth movement of a piston or plunger inside a cylinder. It is a positive displacement pump.

Applications:

- Small water supply systems.
- High-pressure applications.
- Water lifting from certain wells.

C. Submersible Pumps

A submersible pump is installed completely below the water level. The pump and motor are designed to operate underwater.

Applications:

- Borewell irrigation.
- Deep groundwater lifting.
- Agricultural water supply.

D. Axial Flow Pumps

An axial flow pump moves water parallel to the pump shaft. It is suitable for handling large quantities of water at relatively low heads.

Applications:

- Canal irrigation.
- Flood drainage.
- Low-lift irrigation systems.

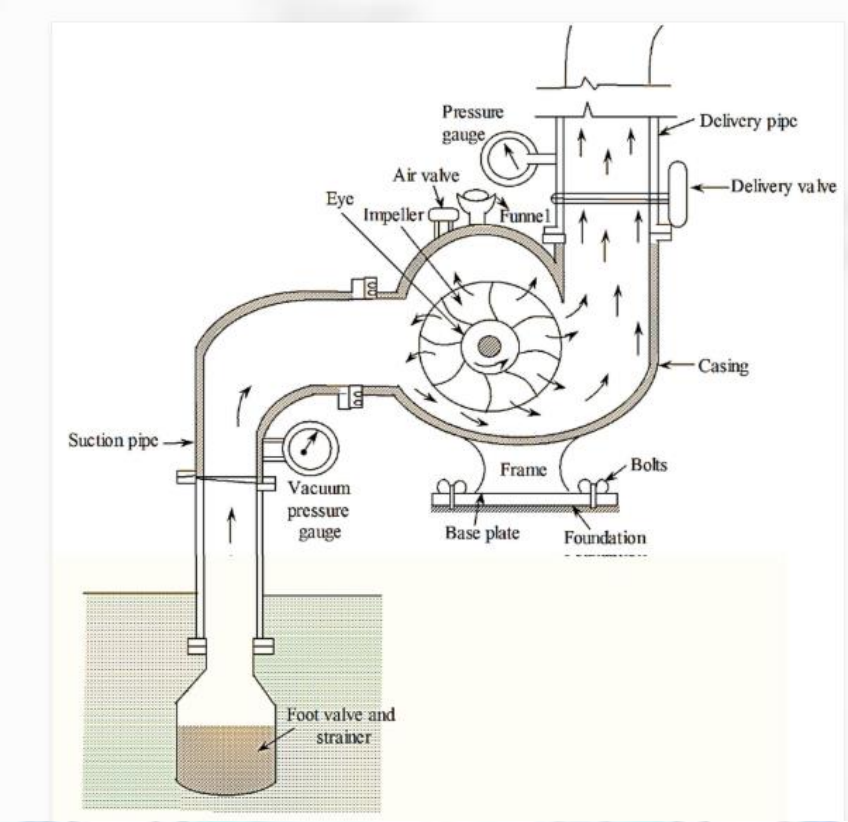
E. Mixed Flow Pumps

Mixed flow pumps combine the characteristics of centrifugal and axial flow pumps. Water moves partly in the radial direction and partly in the axial direction.

Applications:

- Agricultural irrigation.
- River water lifting.
- Large-scale water distribution.

4. Centrifugal Pump – Construction and Working



Main Components

1. Impeller – Rotating component that transfers energy to water.
2. Casing – Encloses the impeller and directs water flow.
3. Suction pipe – Draws water from the source.
4. Foot valve – Prevents reverse flow of water.
5. Strainer – Prevents the entry of unwanted materials.
6. Delivery pipe – Carries water to the irrigation field.
7. Prime mover – Provides mechanical power to operate the pump.

Working Principle

The centrifugal pump works on the principle of centrifugal force.

- Initially, the pump and suction pipe are filled with water. This process is called priming.
- The electric motor rotates the impeller.
- Water enters through the suction pipe at the centre of the impeller.
- The rotating impeller increases the velocity and energy of water.
- Water moves towards the outer edge of the impeller.

- The casing converts part of the velocity energy into pressure energy.
- Water is discharged through the delivery pipe.

5. Important Terms Related to Irrigation Pumps

Term	Explanation
Discharge	Quantity of water delivered per unit time
Head	Energy per unit weight of water, expressed as height
Suction head	Vertical distance between water level and pump centre
Delivery head	Vertical distance between pump centre and delivery level
Total head	Total energy head supplied by the pump
Priming	Filling the pump casing and suction pipe with water
Efficiency	Ratio of useful hydraulic power to input power

6. Pump Performance

The performance of an irrigation pump is evaluated using discharge, head, power and efficiency.

Discharge:

$$Q - \frac{V}{t}$$

Where:

- Q = Discharge (m^3/s)
- V = Volume of water (m^3)
- t = Time (seconds)

Hydraulic Power:

$$P - \frac{\rho g Q H}{1000}$$

Where:

- P = Hydraulic power (kW)
- ρ = Density of water (1000 kg/m^3)
- g = Acceleration due to gravity (9.81 m/s^2)

- Q = Discharge (m^3/s)
- H = Total head (m)

Pump Efficiency:

$$\eta = \frac{\text{Output Power}}{\text{Input Power}} \times 100$$

7. Selection of Pumps for Irrigation

The following factors should be considered while selecting an irrigation pump:

1. Required quantity of irrigation water.
2. Total pumping head.
3. Depth of water source.
4. Type of irrigation system.
5. Availability of electricity or diesel.
6. Pump efficiency.
7. Initial and maintenance costs.
8. Nature of water and suspended impurities.