Introduction

* **Hydropower :-** Hydropower is considered as one of the most economic and non polluting sources of energy. *

- Power generated from water is known as hydro electricity.

- Hydro electricity means electricity generated by hydropower or from the use of the gravitational force of falling of following water.

* Hydro electric power plants :-

- Hydro electric power plants are used to convert the hydraulic potential energy from water into electrical energy. *

- Hydro - electric power station are generally located in hilly areas where dams can build and large water reservoirs can be obtained.

* Hydropower to Electric power :-

* classification of hydro electric power plants by size.

* large hydro :- more than 100 MW

* medium hydro :- 15 - 100 MW

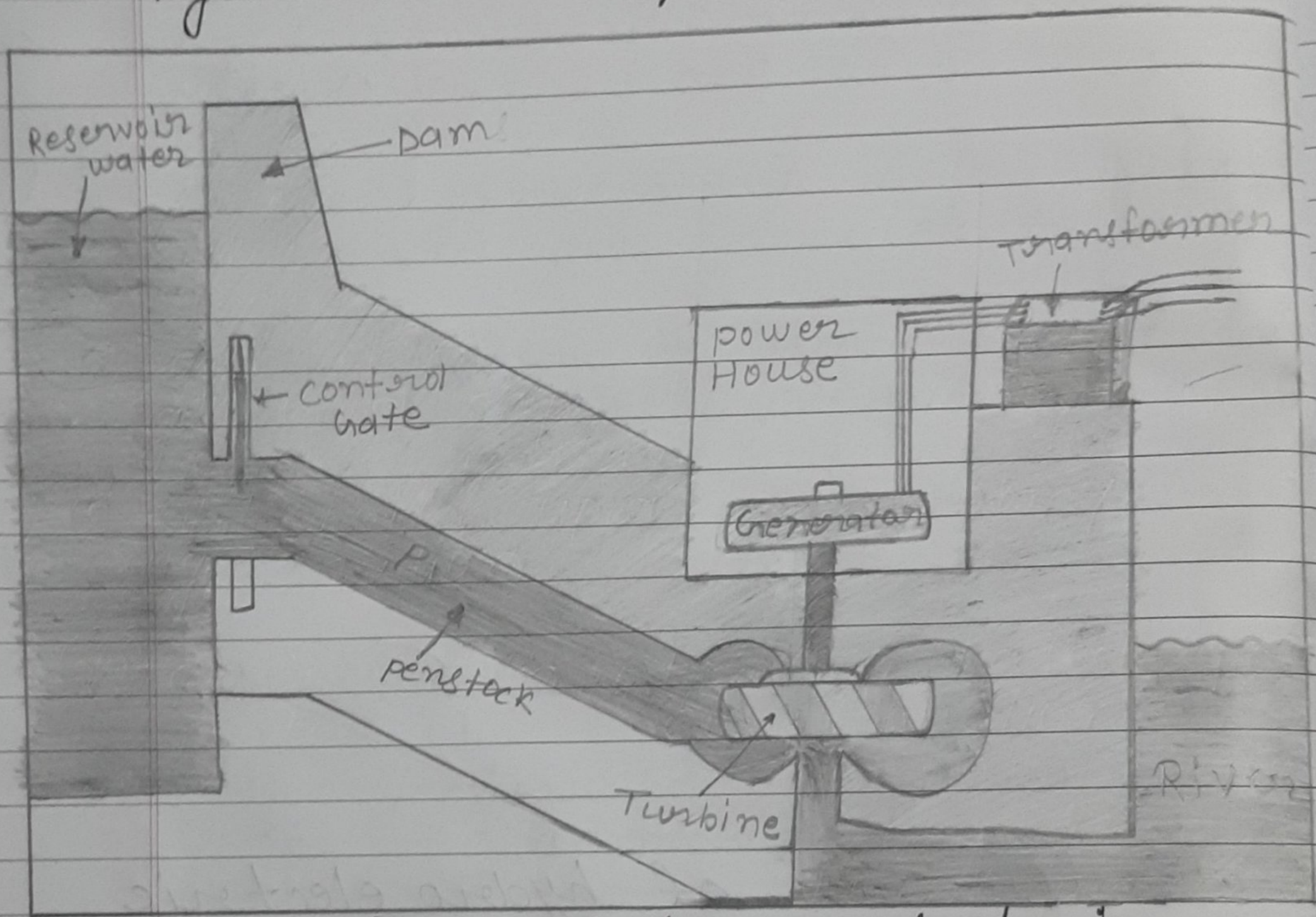
* Small hydro :- 1 - 15 MW

* mini hydro :- above 100 KW, but less 1 MW

* micro - hydro :- from 5 KW up to 100 KW

* pico - hydro :- from a few hundred watt (500 W) up to 5 KW.

* schematic Arrangement of modern hydro electric power plant.



* working of hydro electric power plant:-

- A dam is constructed across the water body.
- water from the catchment area collects at the back of the dam to from reservoir
- water is brought to value of house at the start of penstack.

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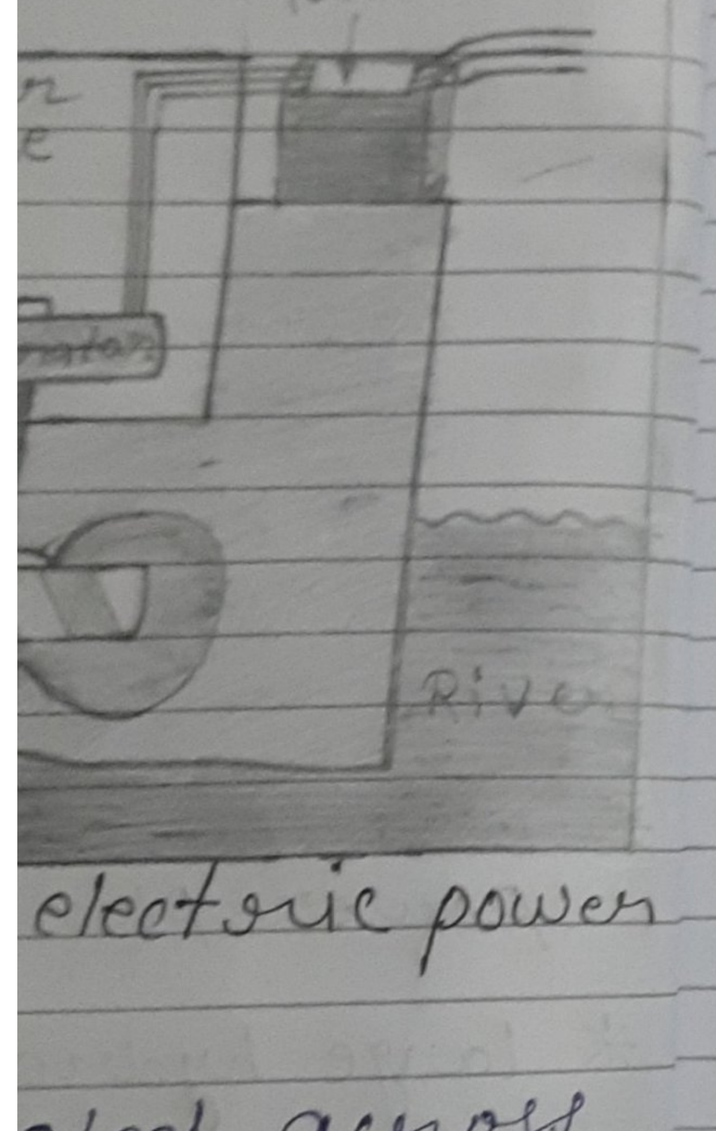

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* Valves:- control condition such as flow pressure, temperature and fluid in power plant.

- The Value house contain, main sluice * valves and automatic isolating valves.
- water is taken to water turbine through a huge steel pipe known as penstack.
- The water turbine converts hydraulic energy into mechanical energy.
- The turbines drives the alternators which converts mechanical energy into electrical energy.

* consituents (areas) of hydro electric power plant:-

① Hydraulic structure
② water turbines
③ Electrical equipment.

① Hydraulic structure:-

Hydraulic structure in a hydro electric power plant include dam, spillways, headworks, surge tank, penstock and accessory works.

(i) Dam:- Dams are structure built over rivers to stop the water flow and from a reservoir.

- A dam performs following two basic functions
- It develops a reservoir of the desired capacity to store water
- It build up a head for power generation

* classification of dam based upon material of construction:-

Dams

fill Dams	Masonry Dams
(1) Earth fill Dam	(1) Gravity dams
(2) Rock fill Dam	(2) Buttress dams
	(3) Arch dams

(ii)

* classification of dams based upon the height of the head :-

* High head :- 100m and above.

* Medium head :- 30 to 100m

* Low head :- 25 to 80 m.

(ii) spillways :- (पानी जाने का रास्ता) A spillways is a protective device used for spilling of water from dams.

- It is used to provide for the release of flood water from a dam.

- It is used to prevent over taping of the dams which could result in damage or failure of dams.

- There are two types :-

(a) uncontrolled type

(b) controlled type

(iii) Head work :-

- The head work consist of the diversion structure at the head of on intake

- They generally include booms and racks for diverting floating debris, sluices for by passing debris and sediments and valves for controlling the flow of water to the turbine.

(iv) Surge tank :-

- Surge tank are tanks connected to the water conductor system.

- It serves the purpose of reducing water hammering in pipes which can cause damage to pipes.

(v) penstocks :-

- penstocks are pipe which carry water from the reservoir to the turbines inside power station.

(vi)

- They are usually made by steel and are equipped with gate systems

- concrete penstocks are suitable for law head. (< 30m).

- water under high pressure flows through the penstock.

(vi) power station:-

- power station contains a turbine coupled to a generator.

- The water brought to the power station rotates the vanes of the turbines producing torque and rotation of turbine shaft.

- This rotational torque is transfered to the generator and is converted into electricity.

- The used water is released through the tail race.

* Equipment provided by power Station :-

* Hydraulic turbine
* Electric generators.
* Governoss
* Gate valves.
* Relief valves
* water circulation pumps
* Air duct
* switch board and instruments
* Storage batteries
* cranes.

(2) water turbines :-

- The water turbines are used to converts the energy of falling water into mechanical energy which in turn rotates the electric generator coupled to it in producing the electric power

* The principle type of water turbines :-

(a) Impulse turbine

(b) Reaction turbine

Impulse turbine :-

Impulse turbines are one that works under atmospheric pressure such turbines are used for high needs

- In this turbine the entire pressure of water is converted into kinetic energy in a nozzle and the velocity of the jet drives the wheel.
- Rating of pelton / Turgo (impulse) turbine :-
- Rated head : 80 - 1600 m
- Rated flow :- 0.1 - 20 3/s
- Rated speed :- 150 - 1500 rpm
- Rated output :- 100 kw - 80 MW
- Rated efficiency :- 89 %.

(b) * Reaction turbine :-

- The work under pressure much higher than atmospheric pressure.
- This turbine are used for law and medium heads.
- In this turbine water entire the runner partly with pressure energy and partly with velocity head.

* Type of Reaction turbines:-

- 1. francis turbine
- 2. kaplon turbine.

* Rating of fransis turbine :-

- Rated head :- 10-300m
- Rated flow :- 03-200 m^3/s
- Rated speed :- 68.2 - 750 rpm.
- Rated output :- 100 KW - 100 MW
- Rated efficiency :- 93%.

* Rating of kaplon turbine :-

- Rated head :- 2-70m
- Rated flow :- 1-200 m^3/s
- Rated speed :- 68.2 - 750 rpm
- Rated output :- 100 kw - 100 MW
- Rated efficiency :- 93%.

(3) Electrical equipment :-

- The electrical Equipment of a hydroelectric power station include alternators transformer, circuit breaker and other switching and protective devices.

* Advantage of H.P.P. :-

- It requires no fuel as water is used for the generation of electrical Energy.
- It is quite neat and clean as no smoke or ash is produced
- It require very small running charges because water is the source of energy which is available free of cost
- It is comparatively simple in construction and require less maintenance
- It is robust and has a longer life
- It is not require a long starting time like a steam power station

* Disadvantage of H.P.P :-

- It involves high capital cost due to construction of dam.
- There is uncertainty about the availability of huge amount of water due to dependence on weather condition.

- skilled and experienced hands are requiired to build the plant.
- It requiire high cast of transmission lines as the plant is located in hilly areas which are quite away fefom the consumers.

* Choice of site for hydro-electric power station :-

(i) Availability of water :-

since the primary requirement of a hydro electric power station is the availability of huge quantity of water, such plant should be build at a place where adequate water is available at a good head.

(ii) storage of water :-

There are wide variation in water supply from a river or canal during the year. This makes it neccessary to store water by constructiong a dam in order to ensure the generation of power throughout the years.

The storage help in equalising the flow of water so that any excess quantity of water at a certain period of the year can be made availability during times to very law flow in river. This lead to the conclusion that site selected for a hydro-electric plant should be provide adequate facilities for erecting a dam and storage of water.

(iii) cast and type of land :-

The land for the construction of the plant should be available at a reasonable price. further, the bearing capacity of the ground should be adequate to with stand the weight of heavy equipment to be installed.

(IV) Transportation facilities :-

The site selected for a hydro-electric plant should be accessible by rail and road. so that the neccessary equipment and machinary coulal be easily transfered.

It is clear from the above mentioned factors that ideal choice of site for such a plant is near a river in hilly areas where dam can be conveniently built and large reservoirs can be obtained.

* water hammer :-

water hammer also known as hydraulic shock. occurs when :-

1. Sudden valves closure or turbine shutdown
2. water flow abruptly staps, creating pressure wave.
3. pressure wave travels through penstock, causing.

increase pressure, pipe rupture or damage, turbine damage.

* Effect of water hammer :-

- pipe rupture or damage
- turbine damage or failure.
- Generator damage.

- power outage
- Increase maintenance costs
- potential safety risk.

* prevention measure :-

- slow valve closure
- surge tank installation
- pressure relief valves
- flywheel energy storage
- Turbine design modification.

Thermal power plant

A Thermal power plant is a mechanism ~~institude~~ insituted to convert heat energy to electrical Energy for domestic and commercial use. During the prooduction of electricity, steam operated turbines transform heat into mechanical and then electric power.

In thermal power plant steam is produced at high pressure and temperature using the heat energy prioduced through solid fuel combustion (most often coal). The turbine shaft connected to the generator rotates with the help of this steam. The generator transforms the turbine impeller's kinetic energy into electrical energy.

* working of a thermal power plant:

- fuel combustion :- fuel such as, coal, natural gas or oil is burned in the boiler. The combustion of the fuel releases ~~that~~ heat, which is transferred to the water in the boiler

- steam generation :- The heat from the combustion of the fuel turns the water in the boiler into steam. The steam is then superheated which further increase its pressure and temperature

- steam Expansion :- The super heated steam is then directed onto the blades of the turbine. The high pressure steam expand and force the turbines blades to rotate.

- Electricity Generation :- The turbine is connected to the generator. It will convert the mechanical Energy of the rotating turbine into Electrical Energy. This Electrical energy is then transmitted to the power pride.